ESKOM KIMBERLEY STRENGTHENING PHASE 4 PROJECT: BOUNDARY-ULCO
FINAL SPECIALIST REPORT FOR THE ENVIRONMENTAL IMPACT PHASE

FRESHWATER STUDY

FEBRUARY 2015

Prepared By:

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TITLE:	Eskom Kimberley Strengthening Phase 4 Project: Boundary-Ulco, Final Specialist Report for the Environmental Impact Phase, Freshwater Study
PROJECT NUMBER:	P111-Oct 13
AUTHORS:	Toni Belcher and Dana Grobler
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Client project reference

APPROVED BY Mr Dana Grobler

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APPROVED by Client

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EXECUTIVE SUMMARY

This freshwater assessment is intended to inform the authorisation process for the proposed Eskom Kimberley Strengthening Phase 4 Project between the Boundary and Ulco Substations. Approximately 94km of double circuit 400kV power line is proposed from the Boundary Substation to the Ulco Substation, including a new Ulco TX (Transmission) Substation adjacent to the existing Ulco DX (Distribution) Substation. Three alternative routes are considered in the Scoping Phase and two final routes considered for the Environmental Impact Phase, where a 2km wide corridor was investigated for all the route alternatives. A 5km radius was also considered around the substation sites.

The aquatic features occurring within the study area consist of the lower Vaal and Harts rivers and some endorheic pans and streams or drainage lines. The habitat integrity of the Lower Vaal and Lower Harts rivers within the study area is deemed to be in a largely to severely modified state while all of the other tributaries in the area are in a largely natural to moderately modified state. The riparian habitat tends to be more impacted by the surrounding farming activities. The pans in the study area are subjected to physical habitat modification with some flow and water quality modification largely as a result of the surrounding farming and peri-urban activities. In terms of the current ecological state of the wetland areas, they are as a whole considered to be in a moderately modified state.

The ecological importance and sensitivity of the rivers within the study area is deemed to be high or moderate, with the Lower Vaal River upstream of the Harts River confluence having the highest ecological importance. The smaller drainage lines have a low ecological significance. The pans within the study area are in general small and of limited ecological importance.

Where the proposed power lines are located close to freshwater features it is proposed that a buffer of 50 from the centre of the drainage lines or from the top of bank of the Vaal, Steenbok and Harts rivers and approximately 500m (varies depending on wetland cluster) from the edge of the pans be implemented. Tributaries of the Vaal and Harts River occur more than 3km to the north and south-west of the existing substation. The new Ulco Substation should therefore preferably be located to the east of the existing substation.

Providing that the recommended mitigation measures are implemented (adherence to the proposed buffers adjacent to freshwater features, minimisation of impacts and rehabilitation of disturbed areas and the utilisation of the existing access roads where possible) the significance of the impact for all of the proposed activities of the alternatives of final route selection is expected very low, both within the construction and operation phases of the project. Thus Alternative One and Two would both have impacts of a low significance on the freshwater features in the area.

A water use authorization may need to be obtained from the Department of Water Affairs Northern Cape Regional Office for approval of the water use aspects of the proposed activities.

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1. BACKGROUND AND QUALIFICATIONS OF SPECIALIST CONSULTANTS

Contact details: PO Box 455, Somerset Mall, 7137

Name: Mr Dana Grobler and Ms Antonia Belcher

Profession: Mr Dana Grobler (Environmental Scientist – *Pr. Sci. Nat 400058/93*) and Ms Antonia Belcher (Aquatic Scientist *Pr. Sci. Nat.* 400040/10);

Fields of Expertise: Specialist in environmental water requirements, river and wetland monitoring and reporting.

Relevant work experience:

Due to Ms Belcher's involvement in the development and implementation of the River Health Programme as well as the Resource Directed Measures (RDM) directorate of the Department of Water Affairs in the Western Cape, she have been a key part of the team that has undertaken six catchment or area wide 'state-of-river' assessments as well as routine monitoring and specialised assessments of rivers and wetlands in all the major catchments in the Western Cape. Ms Belcher and Mr Grobler have also undertaken the River Health Monitoring for the Free State Region in 2011 and 2012.

Relevant publications:

- Belcher T and Grobler D. (2013). Freshwater Assessment for the proposed electrification of the Mission Station, Farm Goedverwacht No. 146, Piketberg
- Belcher T and Grobler D. (2013).Freshwater Assessment for the Proposed Eskom De Hoek-Mountain 66kv Powerline and Associated Infrastructure, Piketberg
- Belcher T and Grobler D. (2013).Freshwater Assessment for the Proposed upgrading of the Eskom Firgrove Substation
- Belcher T and Grobler D. (2013). Freshwater Assessment for the Proposed 11kv Overheard Power Line linked to the Eskom Palmiet Substation
- Belcher T and Grobler D. (2013). Freshwater Assessment for Kwaggaskloof-Hammanshof 66kv Line Refurbishment near Worcester
- Grobler D and Belcher T. (2013). Freshwater Assessment for the Proposed Eskom Groblershoop 132/22kv Substation and the Garona – Groblershoop 132kv Kingbird Line of Approximately 20 Km
- Grobler D and Belcher T. (2013). Proposed Development of the Gamka River 66kv Substation and Associated 66kv Overhead Powerline (150m), Calitzdorp, Western Cape
- Grobler D and Belcher T. (2013). Proposed Development of the Bluewater Eskom Substation and Power Line, Western Cape
- Grobler D and Belcher T. (2013). Freshwater Assessment for Proposed Eskom Bredasdorp-Arniston 66kv Powerline Re-Build And Dismantling of the Old Powerline
- Grobler D and Belcher T. (2013).Freshwater Assessment for Proposed Eskom Muldersvlei-Plattekloof Powerline

2.1 DECLARATION OF INDEPENDENCE (MR DANA GROBLER)

I, Dana Grobler, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- have no and will not have any vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.

Note: The terms of reference is included in the following section.

Signature of the specialist:

Mr Dana Grobler
Date: 31 March 2014

2.2 DECLARATION OF INDEPENDENCE (MS ANTONIA BELCHER)

I, Antonia Belcher, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- have no and will not have any vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
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- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.

Note: The terms of reference is included in the following section.

Signature of the specialist:

Ms Antonia Belcher
Date: 31 March 2014

3. TERMS OF REFERENCE

The suggested and agreed upon work programme based on the above terms of reference were:

Task 1: Freshwater Assessment

Task 1.1: Literature Review and assessment of existing information

Conduct a review of existing studies, reports and data of the area and the detail on the proposed power line routes and substations.

Task 1.2 – 1.4: Site Assessment of the freshwater ecosystems that may be impacted upon by the proposed development activities

Undertake a site assessment according to the brief provided. This will include:

- 4 day site assessment
- Detailed site assessment of priority areas identified
- Walk down of critical points along the routes

Task 1.5 – 1.7: Compilation of the report: Impact assessment

Based on the data and information collected in the previous tasks, describe ecological characteristics of the freshwater systems to be impacted. Evaluate the proposed development activities and their potential impacts, and propose mitigation measures for the development. Describe the potential impacts, the significance of those impacts, and weigh and rank each impact during the project life cycle stages, according to the assessment, ranking, weighting and scaling criteria as laid out in the EIA Regulations. Write up findings and recommendations for EIA process into a report and use in the water use licence.

Task 1.8: Review reports and findings in line with alternative options presented

Submit the report to the Department of Water Affairs (Free State and Northern Cape) and liaise with the officials in terms of the recommendations of the report.

Task 2: Compilation of the documentation for submission of the water use authorisation application (WULA) to the Department of Water Affairs

- Collate all relevant information for the water use authorisation application (a list of the typical information/documentation that we will need for the application is attached);
- Compile licence application forms and supporting documentation and reports for the section 21 c and i applications; and
- Review and liaison with client and DWA (Free State and Northern Cape).

4. LIMITATIONS AND ASSUMPTIONS OF THE STUDY

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. The following techniques and methodologies were utilized to undertake this study:

- Analysis of the freshwater ecosystems was undertaken according to nationally developed methodologies as defined by DWA as part of the national River Health Programme (RHP) and was undertaken at a rapid level. This level is considered to be sufficient for the project. Site assessments were undertaken in January 2014.
- Recommendations are made with respect to the adoption of buffer zones associated with the proposed project, based on the wetlands/river's functioning and site characteristics. These recommendations are based on professional opinion.

5. USE OF THIS REPORT

This report reflects the professional judgment of its authors. The full and unedited content of this should be presented to the client. Any summary of these findings should only be produced in consultation with the author.

6. STUDY OVERVIEW

6.1. OVERVIEW OF THE PROJECT AND STUDY AREA

The town of Kimberley is set in a relatively flat landscape with no prominent topographic features within the urban limits. Hills in the landscape are largely of an artificial nature, created by mining debris dumps associated with more than a century of diamond mining. Since the 1990s these dumps have been recycled and poured back into De Beers Mine, with certain mine dumps being preserved as part of the historic industrial landscape of Kimberley. The surrounding rural landscape consists of relatively flat plains dotted with hills, with mainly outcropping basement andesite rock to the north and north-west.

In terms of rivers, the area is located in the Lower Vaal River Catchment at its confluence with the Harts River. Both of these rivers within the study are have been significantly modified by the surrounding farming activities which has taken place to within the riparian zones of these rivers. As a result levees have been constructed along the river banks, indigenous vegetation has been removed and the riparian vegetation invaded by invasive plants and trees such as Mesquite *Prosopis glandulosa*, Pepper trees *Schinus molle* and Red River Gum *Eucalyptus camaldulensis*.

During the mid-Tertiary geological period, the Palaeo-Kimberley and the Palaeo-Modder systems which once formed part of the Vaal River system were cut off due to headward erosion. The remnants of these palaeo-fluvial systems are today visible as an ancient floodplain with numerous pans. A wide variety of pan types occur namely saltpans, calcareous pans, gypsum pans, clay basin pans and other soils as well as fresh water pans, occur in the region. One of Kimberley's famous features is Kamfers Dam, a large pan north of the city, which is an important wetland supporting a breeding colony of Lesser Flamingos. Conservation initiatives in the area aim to bring people from the city in touch with its wildlife.

Table 1 provides a summary of the main features of the freshwater and hydrological features of the area.

Table 1: Summary of key information related to the water resources which may be impacted by the proposed activities

Descriptor	Name / details	Notes
Water Management Area	Lower Vaal WMA	
Catchment Area	Lower Vaal and Harts Rivers	
Quaternary Catchment	C91D, C91E, C92A C33C	Lower Vaal River Lower Harts River
Present Ecological state	Lower Vaal River (C91 D, E) = D (Largely modified) Lower Vaal River (C92A) = E (Severely modified) Harts River (C33C) = C (Moderately modified)	DWA 2013 DWA 1999
EISC – Ecological Importance and Sensitivity	Lower Vaal River (C91D, E) = High Lower Vaal River (C92A) = Moderate Harts River (C33C) = Moderate	DWA 2013 DWA 1999
Type of water resource	Rivers, Endorheic pans and small drainage lines	
Latitude	28°43'25.2"S	Location of Boundary Substation
Longitude	24°52'49.4"E	
Latitude	28°19'55.0"S	Location of Ulco Substation
Longitude	24°11'59.3"E	
Status of Environmental authorisation process	This freshwater assessment report is prepared as input into the EIA process	Landscape Dynamics Environmental Consultants Postal Address : PO Box 947; Groenkloof; Pretoria; 0027 Tel : 082 566 4530 / 012 460 6043 Fax : 086 685 3822 / 012 346 2356
Site visit	Mr Dana Grobler and Ms Toni Belcher	28 January 2014

Three alternative routes are considered in the Scoping Phase and two final routes considered for the Environmental Impact Phase, where a 2km wide corridor was investigated for all the route alternatives. A 5km radius was also considered around the substation sites.

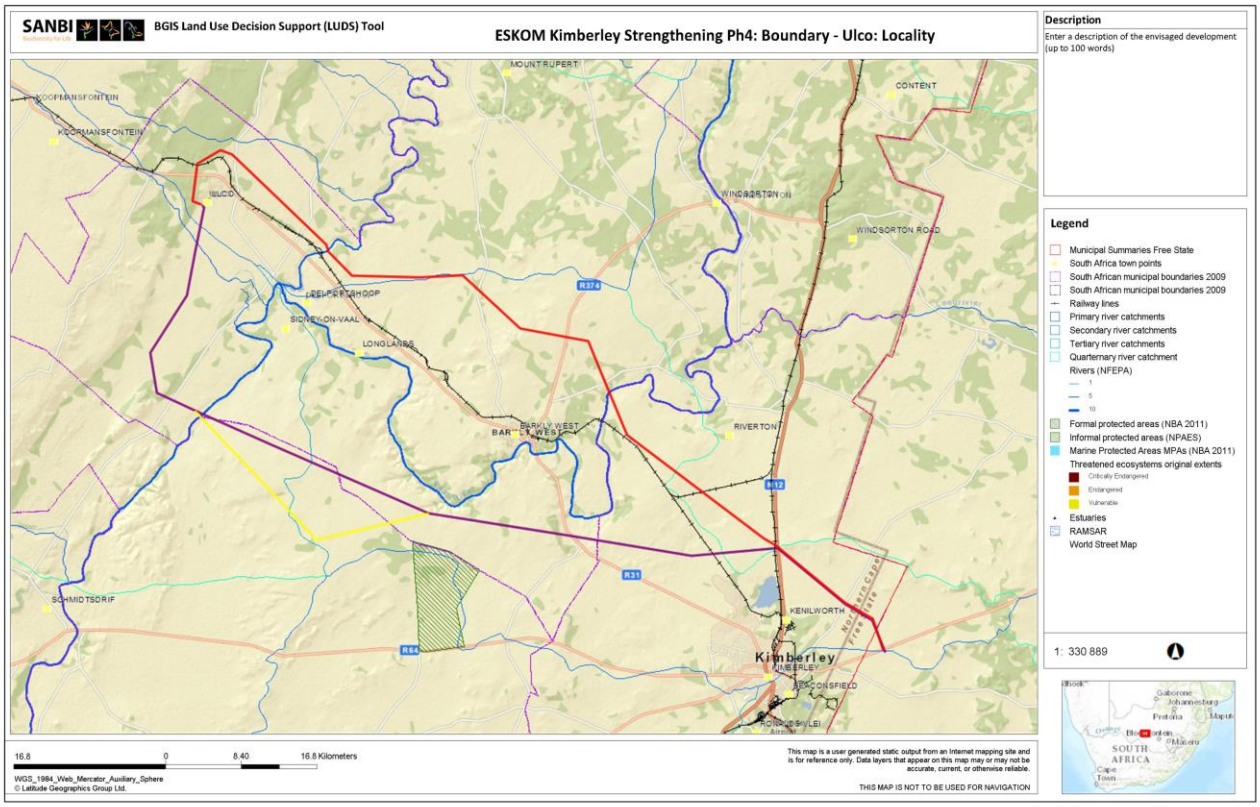


Figure 1: Locality map for the study area with the three alternative routes indicated by the yellow, purple and red lines

6.1.1. VISUAL CHARACTERISTICS

The proposed area in which the power lines are to be constructed is located in the Tokologo Local Municipality in the Free State Province, as well as Sol Plaatjies, Dikgatlong Ulco Local Municipalities in the Northern Cape Province. The Boundary substation at the eastern extent of the study area is located approximately 12 km east of Kimberley and the various power line alternatives run parallel, either north and south, of the R31 road between Kimberley and Ulco. The Ulco Substation at the western extent of the study area is located adjacent to the Ulco Mine.

The majority of the landscape is relatively flat and consists of slightly undulating plains with Ghaap Escarpment at Ulco in the west of the study area and west of the Vaal River downstream of its confluence with the Harts River. The vegetation cover consists of open to sparse low thorn savannah. A few depressions within this landscape have formed endorheic pans that consist mostly of salt pans due to the continued deposition of lime-rich sediments from surface water runoff. The larger of these pans and clusters of pans provide important habitat for biota and in particular avifauna.

Figure 2: View of the typical landscape within the study area as seen on the R31 road where the proposed Alternative 2 and 3 routes cross the road and showing the existing Eskom lines along that route

6.1.2. CLIMATE

Kimberley normally receives about 415mm of rain per year, with most rainfall occurring during summer (Figure 3). The area receives the lowest rainfall in the months June to August (7mm per month) and the highest (76mm) in February/March (Table 2). The average temperatures for Kimberley range from 10°C in June to 25°C in January. The region is the coldest during July when the mercury drops to 3°C on average.

Table 2. Climate data for Kimberley (National Oceanic and Atmospheric Administration)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C	40.4	39.9	36.2	34.9	31.1	26.6	26.8	30.5	35.5	37.6)	39.2	39.7	40.4
Average high °C	32.8	31.0)	28.8	24.7	21.4	18.2	18.8	21.3	25.5	27.8	30.2	32.1	26.1
Daily mean °C	25.1	23.7	21.5	17.3	13.5	10.2	10.4	12.8	17.1	19.7	22.2	24.2	18.1
Average low °C	17.9	17.3	15.2	10.8	6.5	3.2	2.8	4.9	8.9	11.9	14.6	16.6	10.9
Record low °C	7.1	5.6	2.0	−0.3	−5.7	−6.7	−7.9	−6.7	−5.5	−0.5	3.3	4.8	−7.9
Precipitation mm (inches)	57	76	65	49	16	7	7	7	12	30	42	46	414
Avg. precipitation days (≥ 1.0 mm)	7	7	7	6	2	1	1	1	2	4	5	6	49
% humidity	45	53	57	59	54	53	48	41	36	40	42	42	47
Mean monthly sunshine hours	307.1	260.7	265.7	262.0	281.2	264.2	286.7	299.3	288.3	305.1	310.6	331.0	3,461.9

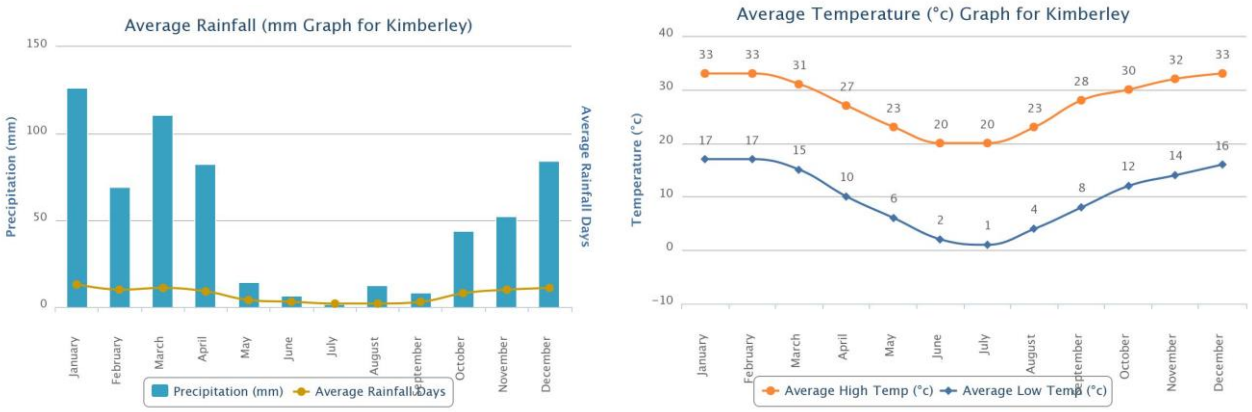


Figure 3: Average monthly rainfall and temperature graphs for Kimberley (worldweatheronline.com)

6.1.3. GEOLOGY AND SOIL

The area is underlain by the Transvaal, Ventersdorp and Karoo Supergroups, which are tertiary to recent secondary deposits. Mainly carbonate rocks predominate, together with surficial deposits, lavas and sub-ordinate shales and dolerites.

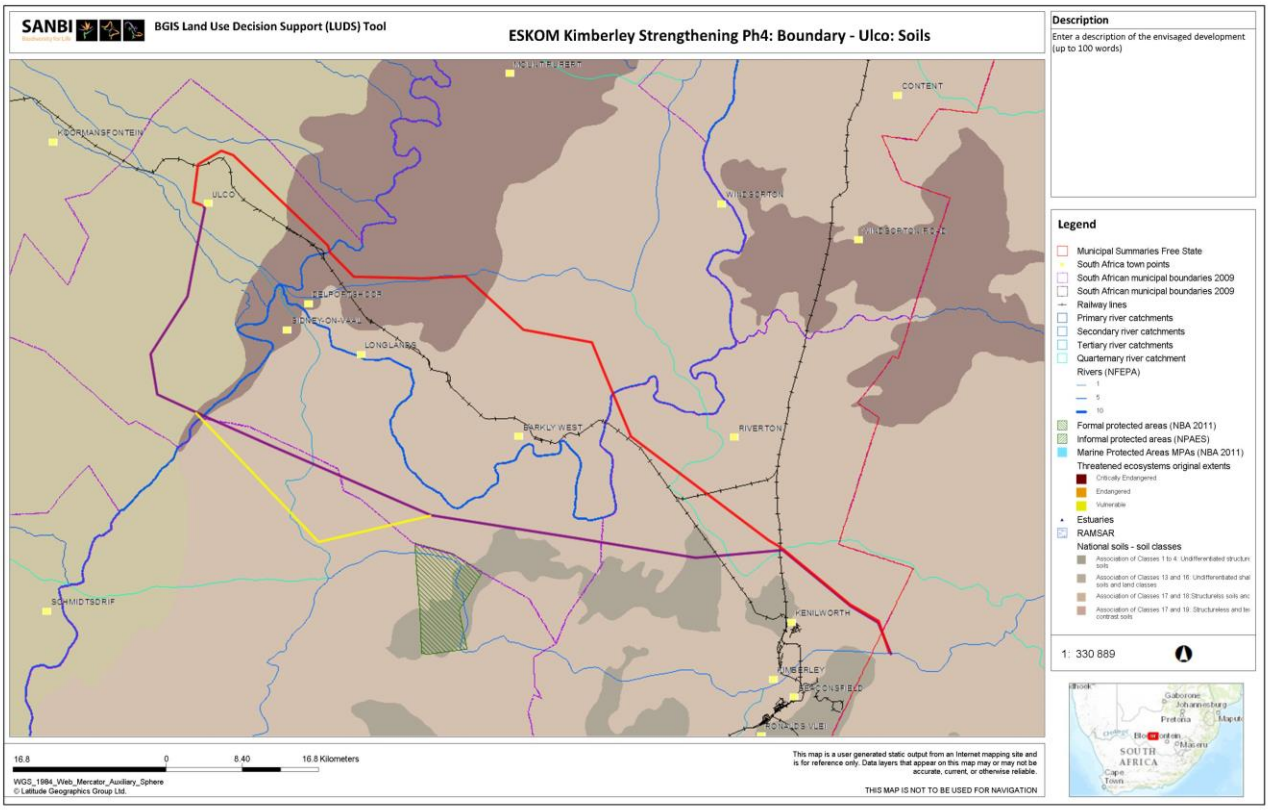


Figure 4: Soils map for the area and surroundings (SANBI Biodiversity GIS)

In general the soils within the study area (pale pink areas in Figure 4) consist mostly of freely drained, structure-less red “Hutton” soils with a high base status that may have restricted soil depth, excessive drainage, high erodibility and low natural fertility. Along the Harts River and surrounding

floodplain and the lower Vaal River (brown in Figure 4), the soils have a marked clay accumulation, are of a restricted depth and have slow water infiltration. In the western portion of the study area (cream areas in Figure 4), the soils are shallow on rock with lime present.

6.1.4. FLORA

The study area consists of the following natural vegetation types, Kimberley Thornveld in the eastern half of the area (light brown in Figure 5), Schmidtsdrift Thornveld in the central portion (medium brown in Figure 5), Ghaap Plateau to the west (darker brown in Figure 5) and patches of Vaalbos Rocky Shrubland (dark grey in Figure 5) to the south of the proposed routes. There are still large portions of these vegetation types remaining and as a result they are considered to be least Threatened.

Other vegetation that may be affected is that of Highveld Salt Pans and the riparian vegetation along the Vaal and Harts rivers. This Highveld Salt Pan vegetation type is considered least threatened and is scattered throughout South Africa where the rainfall ranges between 300 and 500 mm. The riparian vegetation along the Vaal and Harts Rivers is already in a moderately to largely and, in places, severely modified condition as a result of intensive farming activities taking place along the rivers. More detail on the vegetation occurring associated with the pans in the study area is provided in the following section.

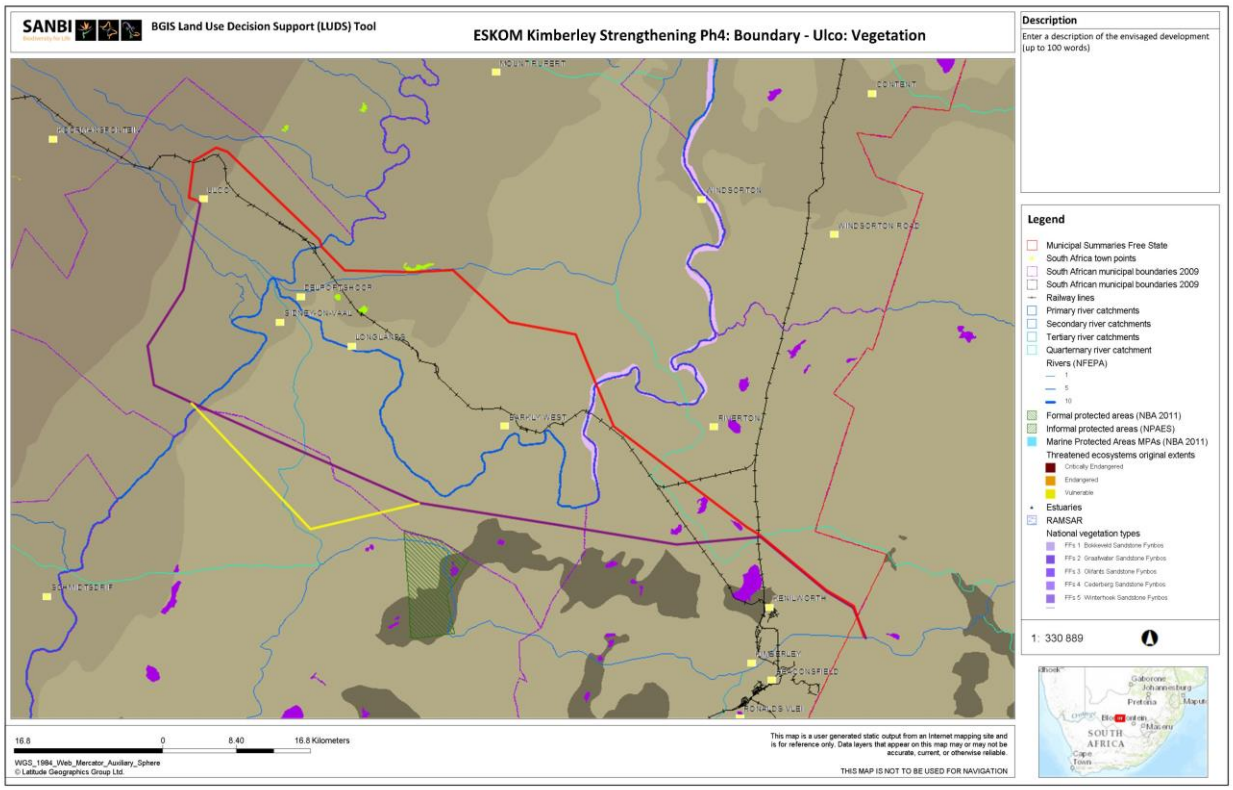


Figure 5: Vegetation map for the area (SANBI Biodiversity GIS)

6.1.5. AQUATIC FEATURES AND FAUNA

The aquatic features occurring within the study area consist of the lower Vaal and Harts rivers and some endorheic pans and streams or drainage lines (Figure 7). Near the confluence of the Harts and Vaal Rivers at Delportshoop a major irrigation system, the Vaal-Harts Scheme was set up in 1933 where water drawn from both the Vaal and the Harts rivers at Warrenton approximately 50km north of the study area to provide water for the intensive irrigation of numerous smallholdings through a system of canals in an otherwise dry area of the country. As a result both rivers are significantly impacted within their lower reaches (Figures 6, 8 and 9). Most of the fish found in the Harts River are introduced species, except in the area of Barberspan a declared nature reserve approximately 230km north-east of the study area, where indigenous species can be found. Many indigenous fish species still however occur within the Lower Vaal River such as the Straightfin barb *Barbus paludinosus* and Orange River mudfish *Labeo capensis*.

The pans (Figure 10) vary slightly in condition and have been primarily disturbed by the grazing of livestock. Many of the pans have been modified into water storage structures while others contain roads, fences and power lines through them. As drainage from the pans is limited, the salinity of the water in the pans rises as water evaporates. Vegetation that can persist in these saline and seasonally inundated conditions consists of low grassy dwarf shrubland.

The ephemeral streams are only visible in the landscape as small grassy or earthen channels with little to no riparian associated vegetation. Larger streams have characteristic Sweet thorn *Acacia Karoo* trees (Figure 11).

Figure 6: The Vaal River upstream of the confluence with the Harts River at the proposed transmission line crossing for Alternative route 1

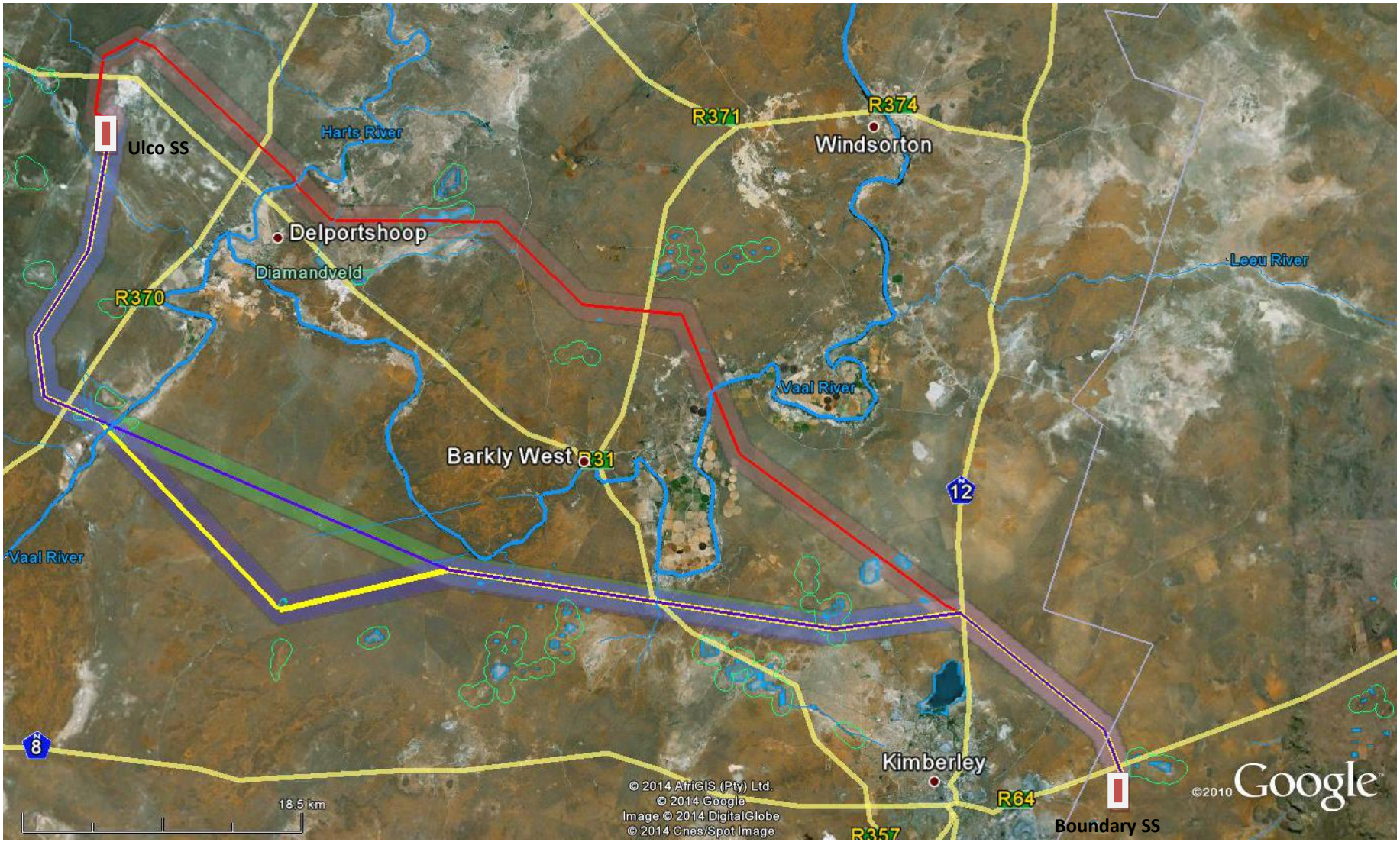


Figure 7: Google Earth image with the proposed alternative routes for the Boundary to Ulco power line and the delineated aquatic features

Figure 8: The Vaal River downstream of the confluence with the Harts River at the proposed transmission line crossing for Alternative routes 2 and 3

Figure 9: The lower Harts River at the proposed transmission line crossing for Alternative route 1

Figure 10: Endorheic pan near Longlands on the Alternative route 1

Figure 11: Small seasonal stream, the Steenbok River, with characteristic Sweet thorn trees along its banks that would be crossed by Alternative route 2 and 3

6.1.6. PROTECTED AREAS

In South Africa two sets of mapping initiatives are available for the study area that are of relevance to the conservation and biodiversity importance of the aquatic ecosystems, that is, the Critical Biodiversity Areas (CBA) map and the Freshwater Ecosystem Priority Areas (FEPA) map. Currently no CBA map exists for the study area. Mapping of the threatened ecosystems has been utilized instead to identify conservation worthy areas. This mapping is however largely associated with terrestrial vegetation types. There are no terrestrial vegetation types within the study are that are of conservation importance (all the natural vegetation types in the area are deemed to be least threatened) in Figure 5.

In terms of FEPAs (Figure 12), only a small tributary, the Steenbok River, of the Vaal River near Ulco is considered to be a River Freshwater Ecosystem Priority Area (dark green area in Figure 12) within the study area. River FEPAs are intended to ensure that biodiversity targets for river ecosystems and threatened/near-threatened fish species are achieved, and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to the biodiversity goals of the country.

Wetland clusters also occur within the study area (an yellow outline is drawn around groups of wetlands in Figure 12). Wetland clusters are groups of wetlands that are embedded in a relatively natural landscape. They allow for important ecological processes such as migration of frogs and insects between wetlands. Although wetland condition was a factor in selection of wetland FEPAs, wetlands selected were not necessary in a good condition (A or B ecological category) to be chosen as a FEPA. Wetland FEPAs currently in an A or B ecological condition should be managed to maintain their good condition. Those currently in a condition lower than A or B should be rehabilitated to the best attainable ecological condition.

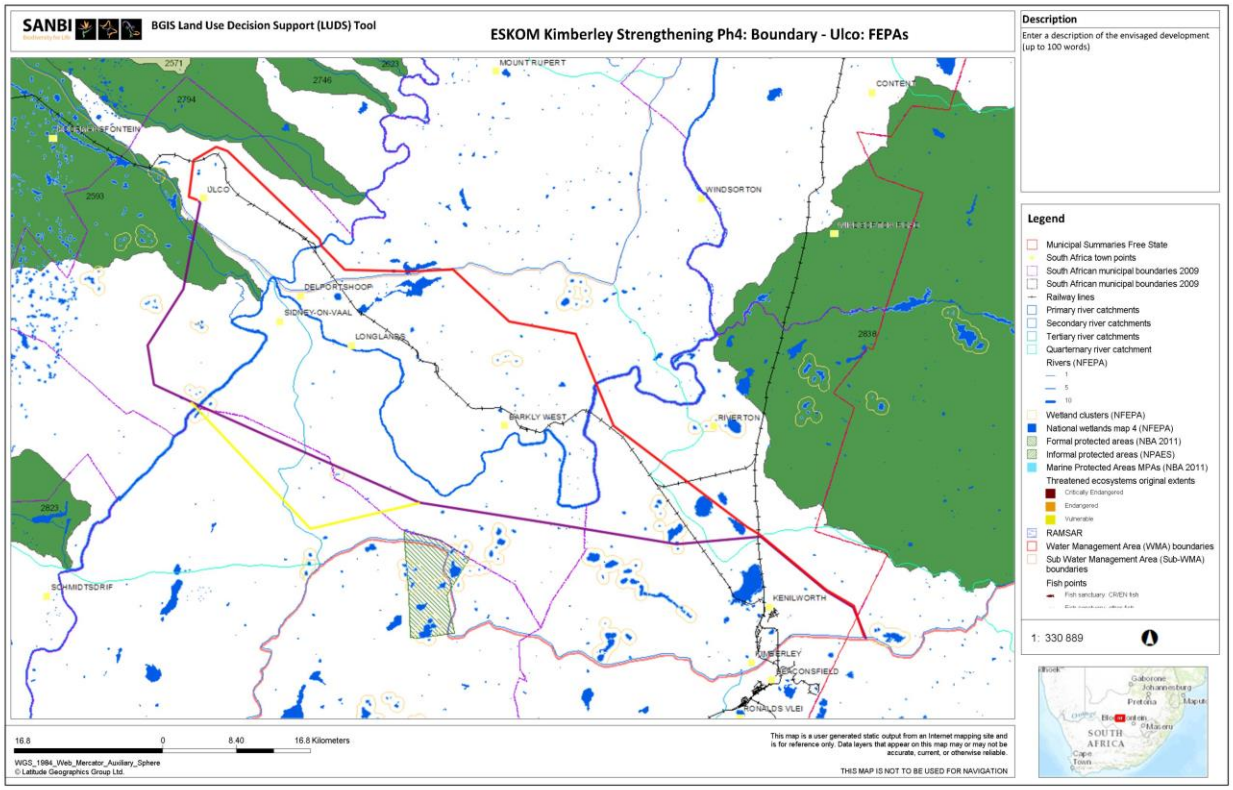


Figure 12: FEPA and threatened ecosystems map for the study area

6.1.7. LAND USE

Land use within the study area consists largely of a mix of natural areas and game or livestock farming (yellow areas in Figure 13). The town of Kimberley lies 10 km to the south of the proposed power line routes and Barkley West and Ulco on the R31 road through the area. A number of Eskom power lines already transect the landscape. Degraded and excavated areas are scattered throughout the area where either intensive agriculture or mining activities occur (pink areas in Figure 13).

The Ulco plant is situated on a limestone deposit near Ulco. Here limestone is mined from shallow open pits and crushed on-site to produce cement clinker, the base feedstock for cement.

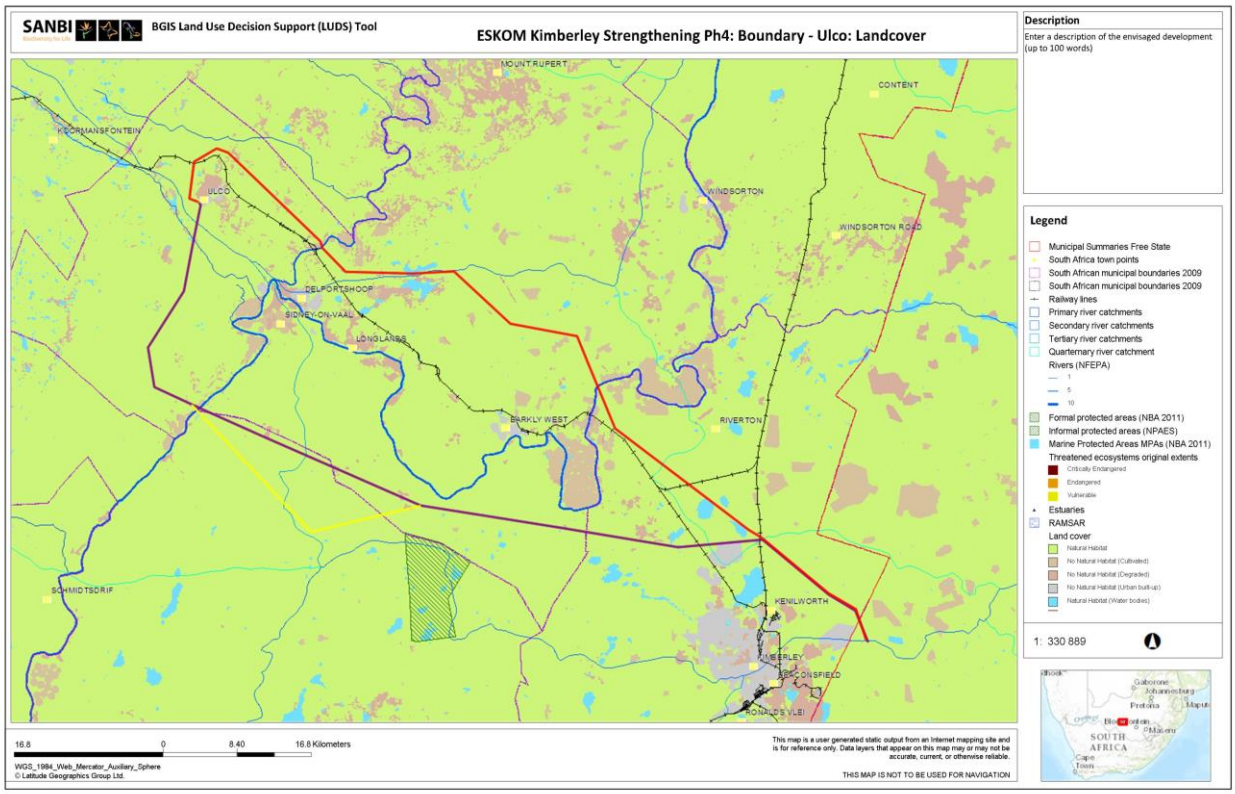


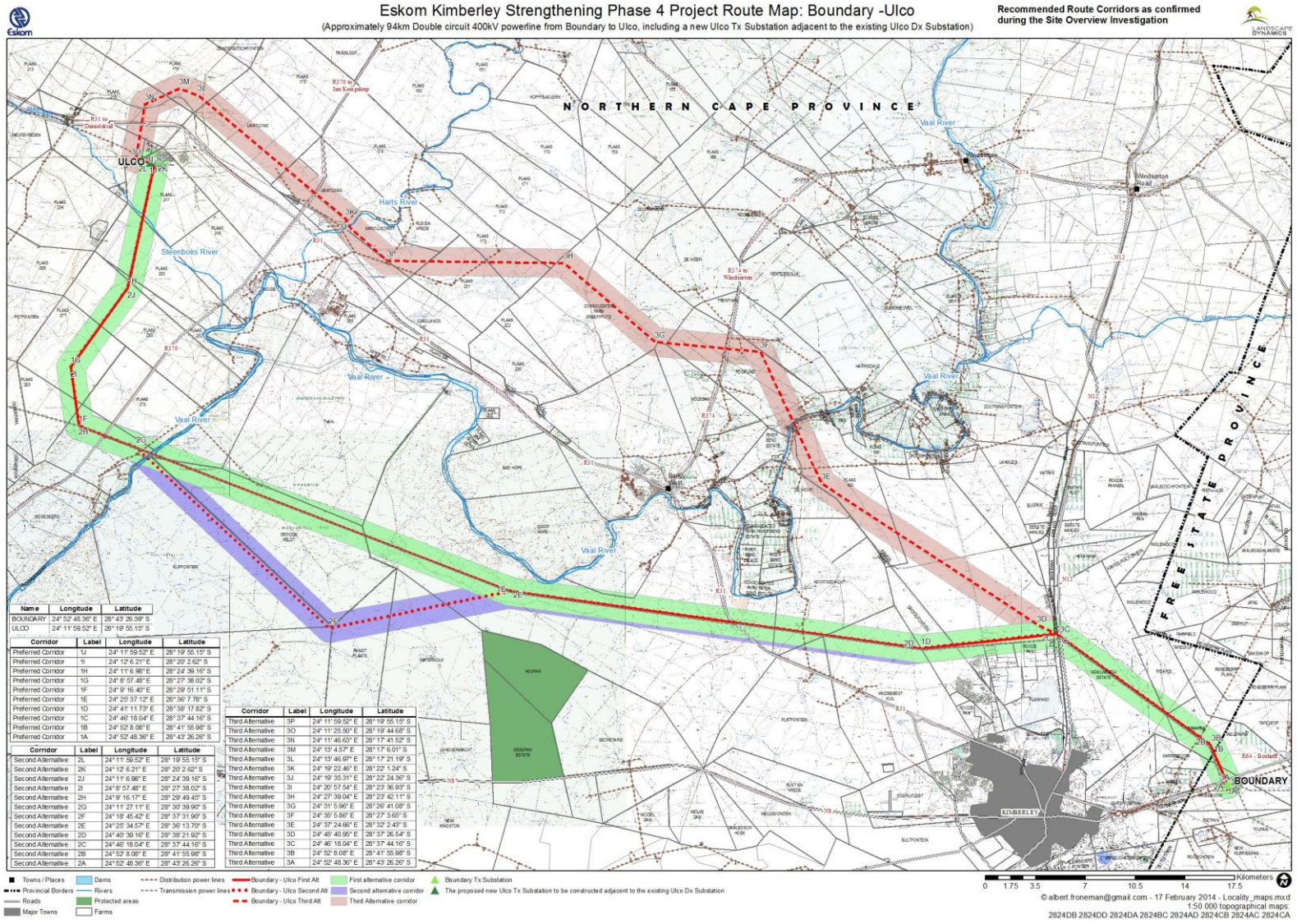
Figure 13: Land use in the area

6.2. ACTIVITY DESCRIPTION

The project will consist of the construction of an approximately 94km double circuit 400kV power line from the Boundary Substation to the Ulco Substation, including a new Ulco TX (Transmission) Substation adjacent to the existing Ulco DX (Distribution) Substation (Figures 14 and 15).

The Boundary Substation and a short section of the line are situated in the Tokologo Local Municipality in the Free State Province. The line runs in a westerly direction and then enters the Northern Cape Province north of Kimberley. It runs through the areas of the Sol Plaatjies and the Dikgatlong Local Municipalities and ends at the small mining town of Ulco. A number of different route alternatives were investigated in the Scoping and Environmental Impact Phases.

The farms that could be potentially affected include, but are not limited to, various portions of the Farms Kareeboom, Tablefarm, Kareeboom, Samaria, Picardi, Kenilworth Estate, Pad, Roodepan, Phoenix, Pijpkaneelpunt, Droogfontein, 193, Kameel Draai, Wildebeest Kuil, Platfontein, Nooitgedacht, De Hoop, Riverbend Estate, Holsdam, Rosalind, 255, Le Grange, Barkly West, Greeffputs, Zoudpansdrift, 173, 220, 221, Karolusdrift, Delportshoop, 317, Likatlong, 176, 216, 215, 281, Than, Waterkolk, Randt Plaats, Vogelstruis Pan, Klipfontein, Drooge Veldt, Mozib, 278, 293, 293, 277, 233, 232 and 217.



Name	Longitude	Latitude
BOUNDARY	24° 52' 48.36" E	28° 43' 26.39" S
ULCO	24° 11' 59.52" E	28° 19' 55.15" S

Corridor	Label	Longitude	Latitude
Preferred Corridor	1J	24° 11' 59.52" E	28° 19' 55.15" S
Preferred Corridor	1I	24° 12' 6.21" E	28° 20' 2.62" S
Preferred Corridor	1H	24° 11' 6.96" E	28° 24' 39.16" S
Preferred Corridor	1G	24° 8' 57.48" E	28° 27' 36.02" S
Preferred Corridor	1F	24° 9' 16.40" E	28° 29' 51.11" S
Preferred Corridor	1E	24° 29' 37.12" E	28° 36' 7.76" S
Preferred Corridor	1D	24° 41' 11.73" E	28° 38' 17.62" S
Preferred Corridor	1C	24° 46' 18.04" E	28° 37' 44.16" S
Preferred Corridor	1B	24° 52' 8.08" E	28° 41' 55.98" S
Preferred Corridor	1A	24° 52' 48.36" E	28° 43' 26.26" S

Corridor	Label	Longitude	Latitude
Second Alternative	2L	24° 11' 59.52" E	28° 19' 55.15" S
Second Alternative	2K	24° 12' 6.21" E	28° 20' 2.62" S
Second Alternative	2J	24° 11' 6.96" E	28° 24' 39.16" S
Second Alternative	2I	24° 8' 57.48" E	28° 27' 36.02" S
Second Alternative	2H	24° 9' 16.17" E	28° 29' 49.45" S
Second Alternative	2G	24° 11' 27.11" E	28° 30' 39.90" S
Second Alternative	2F	24° 18' 45.42" E	28° 37' 31.90" S
Second Alternative	2E	24° 25' 34.57" E	28° 36' 13.70" S
Second Alternative	2D	24° 40' 39.16" E	28° 38' 21.92" S
Second Alternative	2C	24° 46' 18.04" E	28° 37' 44.16" S
Second Alternative	2B	24° 52' 8.08" E	28° 41' 55.98" S
Second Alternative	2A	24° 52' 48.36" E	28° 43' 26.26" S

Corridor	Label	Longitude	Latitude
Third Alternative	3P	24° 11' 59.52" E	28° 19' 55.15" S
Third Alternative	3O	24° 11' 25.50" E	28° 19' 44.68" S
Third Alternative	3N	24° 11' 46.63" E	28° 17' 41.52" S
Third Alternative	3M	24° 13' 4.57" E	28° 17' 6.01" S
Third Alternative	3L	24° 13' 46.97" E	28° 17' 21.19" S
Third Alternative	3K	24° 19' 22.46" E	28° 22' 1.24" S
Third Alternative	3J	24° 19' 35.31" E	28° 22' 24.36" S
Third Alternative	3I	24° 20' 57.54" E	28° 23' 36.93" S
Third Alternative	3H	24° 27' 39.04" E	28° 23' 42.11" S
Third Alternative	3G	24° 31' 5.96" E	28° 26' 41.08" S
Third Alternative	3F	24° 35' 5.86" E	28° 27' 3.65" S
Third Alternative	3E	24° 37' 24.66" E	28° 32' 2.43" S
Third Alternative	3D	24° 46' 40.95" E	28° 37' 26.54" S
Third Alternative	3C	24° 46' 18.04" E	28° 37' 44.16" S
Third Alternative	3B	24° 52' 8.08" E	28° 41' 55.98" S
Third Alternative	3A	24° 52' 48.36" E	28° 43' 26.26" S

Figure 14: Plan for the alternative routes under consideration for the transmission line between Beta and Boundary

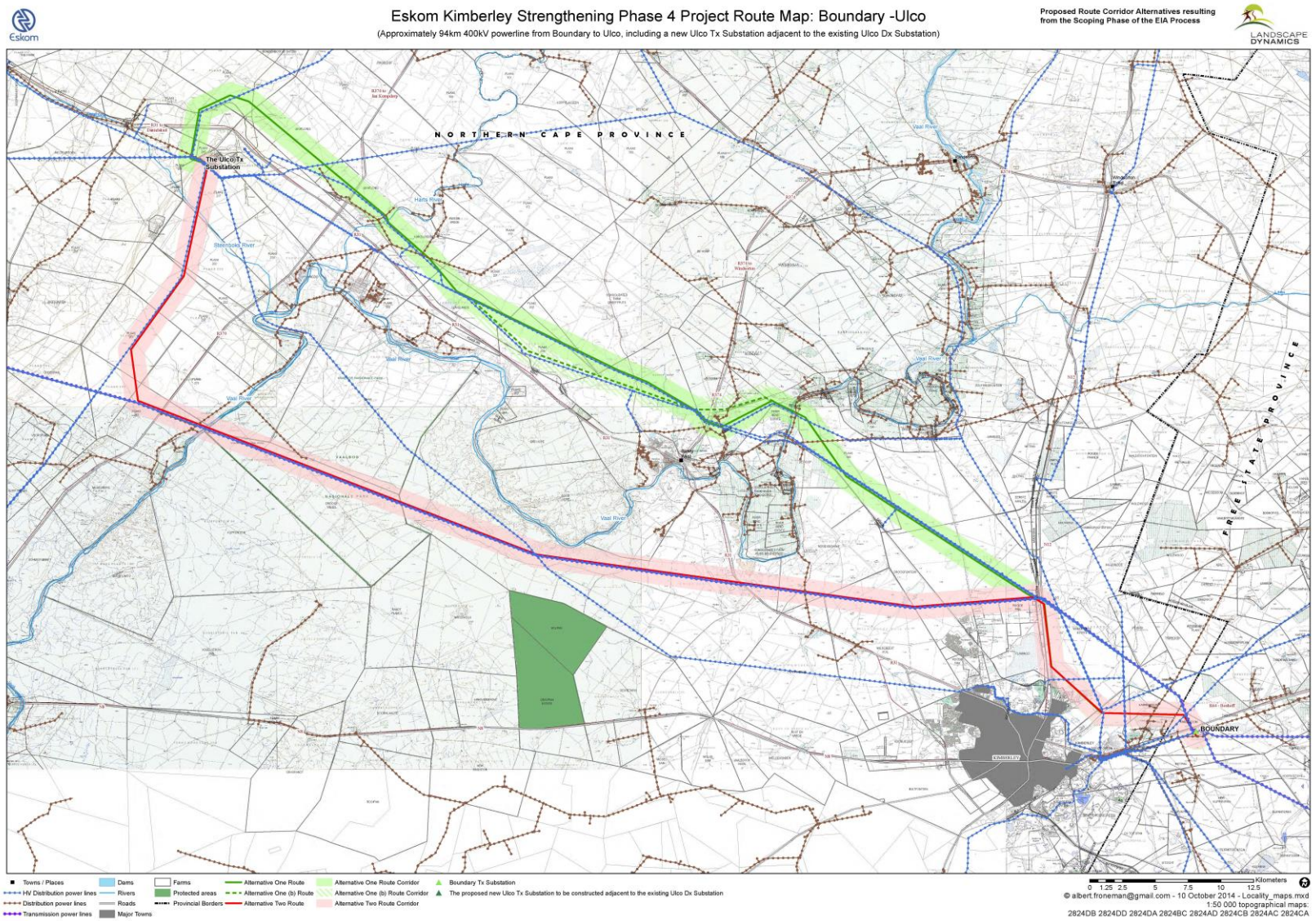


Figure 15: Plan for the alternative routes under consideration in the Environmental Impact Phase for the transmission line between Beta and Boundary

7. AQUATIC SYSTEMS IN THE STUDY AREA

The purpose of the freshwater assessment is to determine the relative importance, sensitivity and current condition (ecological state) in order to assess the impact of proposed development activities on the freshwater resources. The assessment is also required to make recommendations in terms of mitigation measures that can be used to prevent or minimise the impact on the freshwater resources. This assessment of the rivers, smaller streams /drainage lines and pans identified within the study area is based on existing information as well as the field assessment.

7.1. ASSESSMENT OF RIVERS, STREAMS AND DRAINAGE LINES

7.1.2. RIVER TYPING AND CHARACTERISATION

The Index for Habitat Integrity (IHI) and Site Characterisation assessments were utilised to provide information on the ecological condition and physical characteristics of the rivers/streams and any significant drainage lines in the study area (Table 3).

River typing or classification involves the hierarchical grouping of rivers into ecologically similar units so that inter- and intra-river variation in factors that influence water chemistry, channel type, substratum composition and hydrology are best accounted for. Any comparative assessment of river condition should only be done between rivers that share similar physical and biological characteristics under natural conditions. Thus, the classification of rivers provides the basis for assessing river condition to allow comparison between similar river types. The primary classification of rivers is a division into Ecoregions. Rivers within an ecoregion are further divided into sub-regions.

Ecoregions: groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation (DWAF 1999). For the purposes of this study, the ecoregional classification presented in DWAF (1999), which divides the country's rivers into ecoregions, was used. The area lies primarily within the Southern Kalahari Ecoregion with only a small section at Ulco lying within the Ghaap Plateau Ecoregion.

***Characteristics of the Southern Kalahari Ecoregion**: Lowlands, open hills and mountains with moderate to high relief and plains with low relief. Altitude varies from 500 – 1700 a.m.s.l. The natural terrestrial vegetation is a mixture of bushveld types. Rainfall varies from 0 - 500 mm a^{-1} and mean annual temperature is between 14 - 22 °C.*

Sub-regions: sub-regions (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important (Rowntree and Wadeson 1999). The use of geomorphological features is based on the assumption that these are a major factor in the determination of the distribution of the biota.

Table 3. Geomorphological and Physical features for the rivers/streams and any significant drainage lines within the study area

River	Vaal River (u/s Harts River confluence)	Vaal River (d/s Harts River confluence)	Harts River	Steenbok river	Significant drainage lines
Geomorphological zone	Foothill streams				
Lateral mobility or entrenchment	Semi-confined				
Channel form	Simple channel				
Channel pattern	Single thread: low sinuosity				
Channel type	alluvium			Gravel bed with alluvium	
Dominant biotopes	Run/regime		Shallow pools		
Hydrological Type	Perennial		Seasonal to ephemeral minor tributaries		

7.1.2. HABITAT INTEGRITY

The evaluation of Habitat Integrity (HI) provides a measure of the degree to which a river has been modified from its natural state. The methodology (DWAF, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of degradation of a river. The severity of each impact is ranked using a six-point scale with 0 (no impact), 1 to 5 (small impact), 6 to 10 (moderate impact), 11 to 15 (large impact), 16 to 20 (serious impact) and 21 to 25 (critical impact).

The Habitat Integrity Assessment is based on assessment of the impacts of two components of the river, the riparian zone and the instream habitat. Assessments are made separately for both components, but data for the riparian zone are interpreted primarily in terms of the potential impact on the instream component.

The estimated impact of each criterion is calculated as follows:

Rating for the criterion/maximum value (25) x weight (percent)

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components respectively. The total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category (Table 4).

Table 4. Habitat Integrity categories (From DWAF, 1999)

Category	Description	Score (%)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. Large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In worst instances, basic ecosystem functions have been destroyed and changes are irreversible.	0

Table 5. Index of Habitat Integrity Assessment results and criteria assessed for Instream Habitat of the tributaries in the study area

Instream Habitat Integrity	Vaal River (u/s Harts River confluence)	Vaal River (d/s Harts River confluence)	Harts River	Steenbok river	Significant drainage lines
Water Abstraction	14	16	16	4	6
Flow Modification	12	14	15	3	7
Bed Modification	10	11	14	6	8
Channel Modification	10	10	12	4	5
Water Quality	14	14	14	6	6
Inundation	11	10	12	2	6
Exotic Macrophytes	6	5	4	0	2
Exotic Fauna	6	6	4	0	2
Rubbish Dumping	6	6	5	4	4
Integrity Class	**D**	**D/E**	**D/E**	**B/C**	**B/C**

Table 6. Index of Habitat Integrity Assessment results and criteria assessed for the Riparian Habitat of the tributaries in the study area

Riparian Zone Habitat Integrity	Vaal River (u/s Harts River confluence)	Vaal River (d/s Harts River confluence)	Harts River	Steenbok river	Significant drainage lines
Vegetation Removal	7	12	14	7	7
Exotic Vegetation	8	8	9	8	9
Bank Erosion	9	7	8	9	10
Channel Modification	10	10	12	4	5
Water Abstraction	14	16	16	4	6
Inundation	11	10	12	2	6
Flow Modification	12	14	15	3	7
Water Quality	14	14	14	6	6
Integrity Class	**D/E**	**D/E**	**E/F**	**B/C**	**C**

The habitat integrity of the Lower Vaal and Lower Harts rivers within the study area is deemed to be in a largely to severely modified state while all of the other tributaries in the area are in a largely natural to moderately modified state. The riparian habitat tends to be more impacted by the surrounding farming activities.

7.1.3. ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

The EIS assessment considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a scale (Table 7). The median of the resultant score is calculated to derive the EIS category (Table 8).

Table 7. Definition of the scale used to assess biotic and habitat determinants indicate either importance or sensitivity

Scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)

Table 6. Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Table 9. Results of the EIS assessment for the tributaries within the study area

Biotic Determinants	Vaal River (u/s Harts River)	Vaal River (d/s Harts River)	Harts River	Steenbok river	Significant drainage lines
Rare and endangered biota	3	3	2	1	1
Unique biota	2	3	1	1	0
Intolerant biota	3	3	3	1	1
Species/taxon richness	3	2	3	1	1
Aquatic Habitat Determinants					
Diversity of aquatic habitat types or features	4	4	4	1	1
Refuge value of habitat type	2	2	2	1	1
Sensitivity of habitat to flow changes	2	2	2	2	1
Sensitivity of flow related water quality changes	2	2	2	2	1
Migration route/corridor for instream and riparian biota	2	3	2	2	1
National parks, wilderness areas, Nature Reserves, Natural Heritage sites & areas, PNEs	1	1	0	0	0
EIS CATEGORY	**High**	**Moderate**	**Moderate**	**Moderate**	**Low**

The ecological importance and sensitivity of the rivers within the study area is deemed to be high or moderate, with the Lower Vaal River upstream of the Harts River confluence having the highest ecological importance. The smaller drainage lines have a low ecological significance.

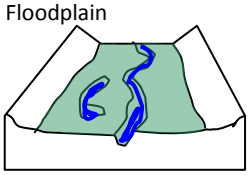
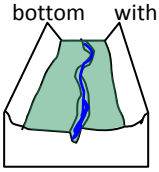
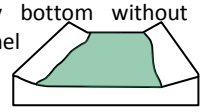
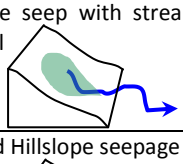
7.2. WETLAND ASSESSMENT

The wetland assessment consists of the following aspects: Wetland classification; Wetland integrity; and Ecosystem services supplied by the wetland.

7.2.1. WETLAND CLASSIFICATION

The classification of the wetlands in the study area into different wetland types was based on the WET-EcoServices technique (Kotze *et al*, 2005). The WET-EcoServices technique identifies seven main types of wetland based on hydro-geomorphic characteristics (Table 10).

Table 10. Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Floodplain 	Valley bottom areas with a well-defined stream channel, gently sloped & characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel 	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/ ***
Valley bottom without a channel 	Valley bottom areas with no clearly defined stream channel usually gently sloped and characterized by alluvial sediment deposition, generally leading to accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
Hillslope seep with stream channel 	Slopes on hillsides, which are characterized by colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans) 	A basin shaped area with a closed elevation contour that allows for accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output

Water source: * Contribution usually small
*** Contribution usually large
*/ *** Contribution may be small or important depending on local circumstances

 Wetland

According to Table 11 the pans/wetland features within the study area can be classified as follows:

Table 11: Classification of wetland areas within study area

Name	Pans along the proposed routes for the Eskom Kimberley Strengthening Phase 4 Project: Boundary to Ulco
System	Inland
Ecoregion	Southern Kalahari
Landscape setting	Depression on a plain
Longitudinal zonation	Not applicable
Drainage	Endorheic (water mostly exists by means of infiltration and evaporation)
Seasonality	Ephemeral
Anthropogenic influence	Some disturbances due to farming (livestock grazing) and infrastructure development (roads, power lines and fences)
Geology	Carbonate rocks predominate, together with surficial deposits, lavas and sub-ordinate shales and dolerites
Vegetation	Kimberley Thornveld in the eastern portion, Schmidtsdrift Thornveld in the western portion
Substrate	Sand/loam
Salinity	Fresh becoming saline through the season

7.2.2. WETLAND INTEGRITY

The Present Ecological Status (PES) Method (DWAF 2005) was used to establish the integrity of the wetlands/pans in the study area and was based on the modified Habitat Integrity approach developed by Kleynhans (DWAF, 1999; Dickens *et al*, 2003). Table 12 shows the criteria and results from the assessment of the habitat integrity of the wetlands. These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland.

Table 12. Habitat integrity assessment criteria for palustrine wetlands (Dickens *et al*, 2003)

Criteria & Attributes	Relevance
Hydrologic	
Flow Modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floralistic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
Water Quality	
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.
Hydraulic/Geomorphic	
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.

Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities that reduce or change wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Over utilisation of Biota	Overgrazing, over fishing, etc.

Table 13. Wetland habitat integrity assessment (score of 0=critically modified to 5=unmodified)

Criteria & Attributes	Pans
Hydrologic	
Flow Modification	3.0
Permanent Inundation	3.5
Water Quality	
Water Quality Modification	2.5
Sediment Load Modification	2.5
Hydraulic/Geomorphic	
Canalisation	3.5
Topographic Alteration	2.7
Biota	
Terrestrial Encroachment	2.5
Indigenous Vegetation Removal	2.5
Invasive Plant Encroachment	3.5
Alien Fauna	3.5
Over utilisation of Biota	3.0
Total Mean	**2.9**
Category	**B/C (moderately modified)**

The pans in the study area are subjected to physical habitat modification with some flow and water quality modification largely as a result of the surrounding farming and peri-urban activities. In terms of the current ecological state of the wetland areas, they are as a whole considered to be in a moderately modified state.

Table 14. Relation between scores given and ecological categories

Scoring Guidelines Per Attribute*	Interpretation of Mean* of Scores for all Attributes: Rating of Present Ecological Status Category (PESC)
Natural, unmodified - score=5.	Within general acceptable range CATEGORY A >4; Unmodified, or approximates natural condition.
Largely natural - score=4.	CATEGORY B >3 and <4; Largely natural with few modifications, but with some loss of natural habitats.
Moderately modified- score=3.	CATEGORY C >2 and <3; moderately modified, but with some loss of natural habitats.

Largely modified - score=2.	CATEGORY D <2; largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
	OUTSIDE GENERALLY ACCEPTABLE RANGE
Seriously modified - rating=1.	CATEGORY E >0 and <2; seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
Critically modified - rating=0.	CLASS F 0; critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

7.2.3. ECOSYSTEM SERVICES SUPPLIED BY THE WETLANDS

The assessment of the ecosystem services supplied by the wetland / pan areas was conducted according to the guidelines as described by Kotze *et* al (2005). An assessment was undertaken that examines and rates the services listed in Table 15. The characteristics were scored according to the general levels of services provided. It is important to ensure that these pans and wetland area can continue to provide the valued goods and services.

Table 15. Goods and services assessment results for wetland (high=4; low=0)

Goods and services	Pans
Flood attenuation	3.0
Stream flow regulation	2.0
Sediment trapping	3.0
Phosphate trapping	2.0
Nitrate removal	2.0
Toxicant removal	1.5
Erosion control	2.5
Carbon storage	1.0
Maintenance of biodiversity	3.0
Water supply for human use	1.0
Natural resources	2.0
Cultivated foods	0
Cultural significance	0
Tourism and recreation	0
Education and research	0

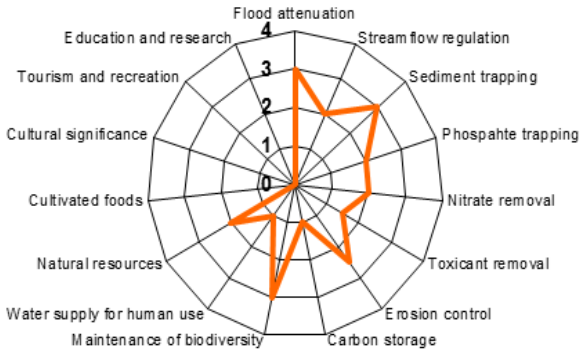


Figure 16. Ecosystem services provided by the wetland area in the study area

From Figure 16 it can be clearly seen that in terms of goods and services, the pans/wetland areas provide valuable services, particularly in terms of provides habitat for aquatic life (water birds) as well as providing some flood attenuation functionality.

8. CONSTRAINTS MAP AND CONSIDERATION OF ALTERNATIVES FOR THE SCOPING PHASE

Table 16 provides an assessment of the proposed project and its alternative routes proposed for the Scoping Phase in terms of the potential impact on the freshwater features within the study area. Figure 17 provides an overview of the freshwater features for these proposed alternative routes. The numbered areas in Figure 17 related to the more details assessments provided in Table 16.

Approximately 94km of double circuit 400kV power line is proposed from the Boundary Substation to the Ulco Substation, including a new Ulco TX (Transmission) Substation adjacent to the existing Ulco DX (Distribution) Substation. Three alternative routes were being considered in the Scoping Phase where a 2km wide corridor was being investigated for all the route alternatives with the wider buffer line in Figure 17 indicating the corridor under consideration. These proposed alternative routes have subsequently been refined based on the input from the specialist studies have been refined and are discussed in the following section.

From the discussion on the potential impacts assessed in this phase of the project and provided in Table 16, it can be seen that the Alternative One and Alternative Two routes would have the least potential impact on the freshwater features within the study area. A buffer of 50 from the centre of the drainage lines or from the top of bank of the Vaal, Steenbok and Harts rivers and approximately 500m (varies depending on wetland cluster) from the edge of the pans is recommended.

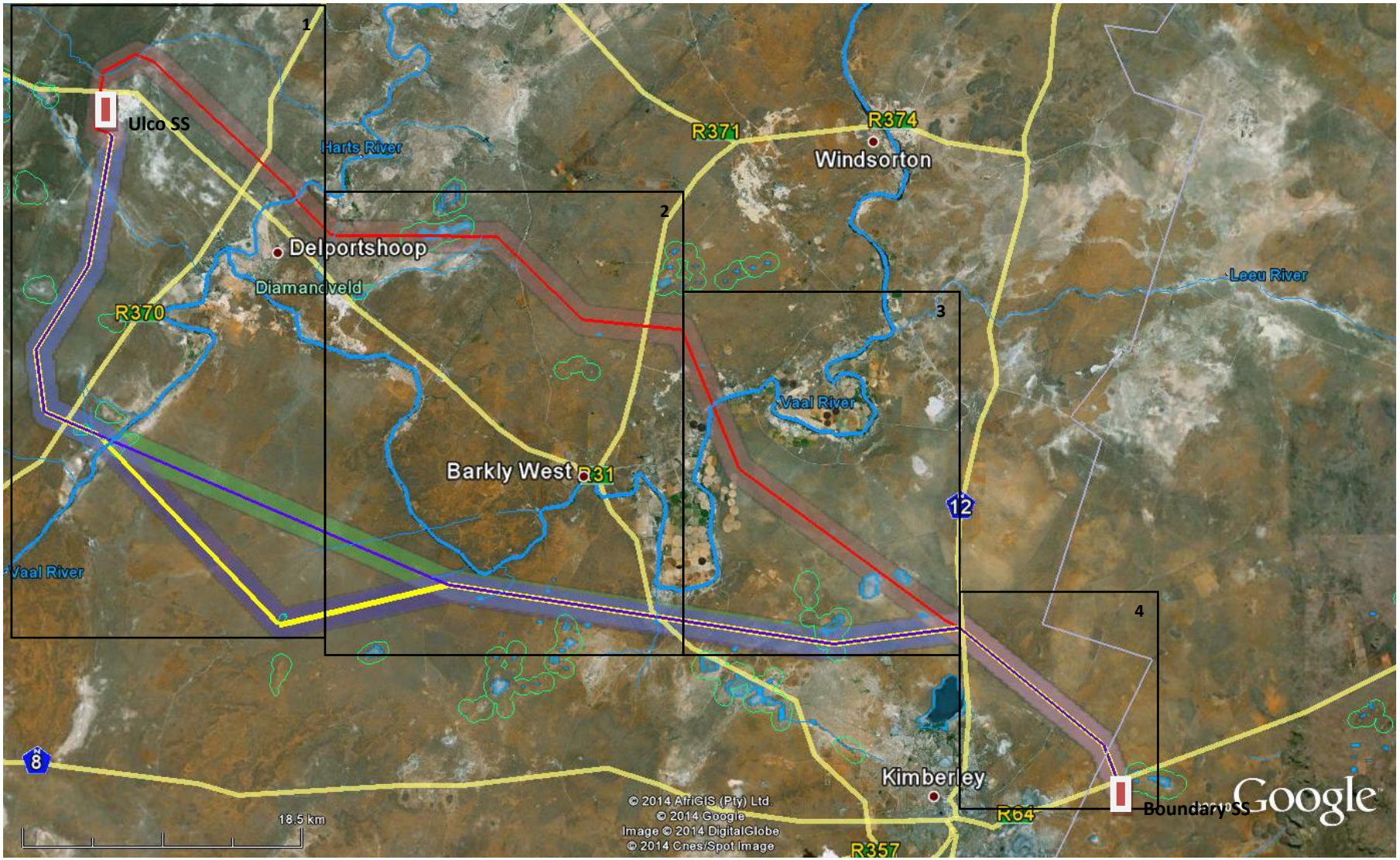
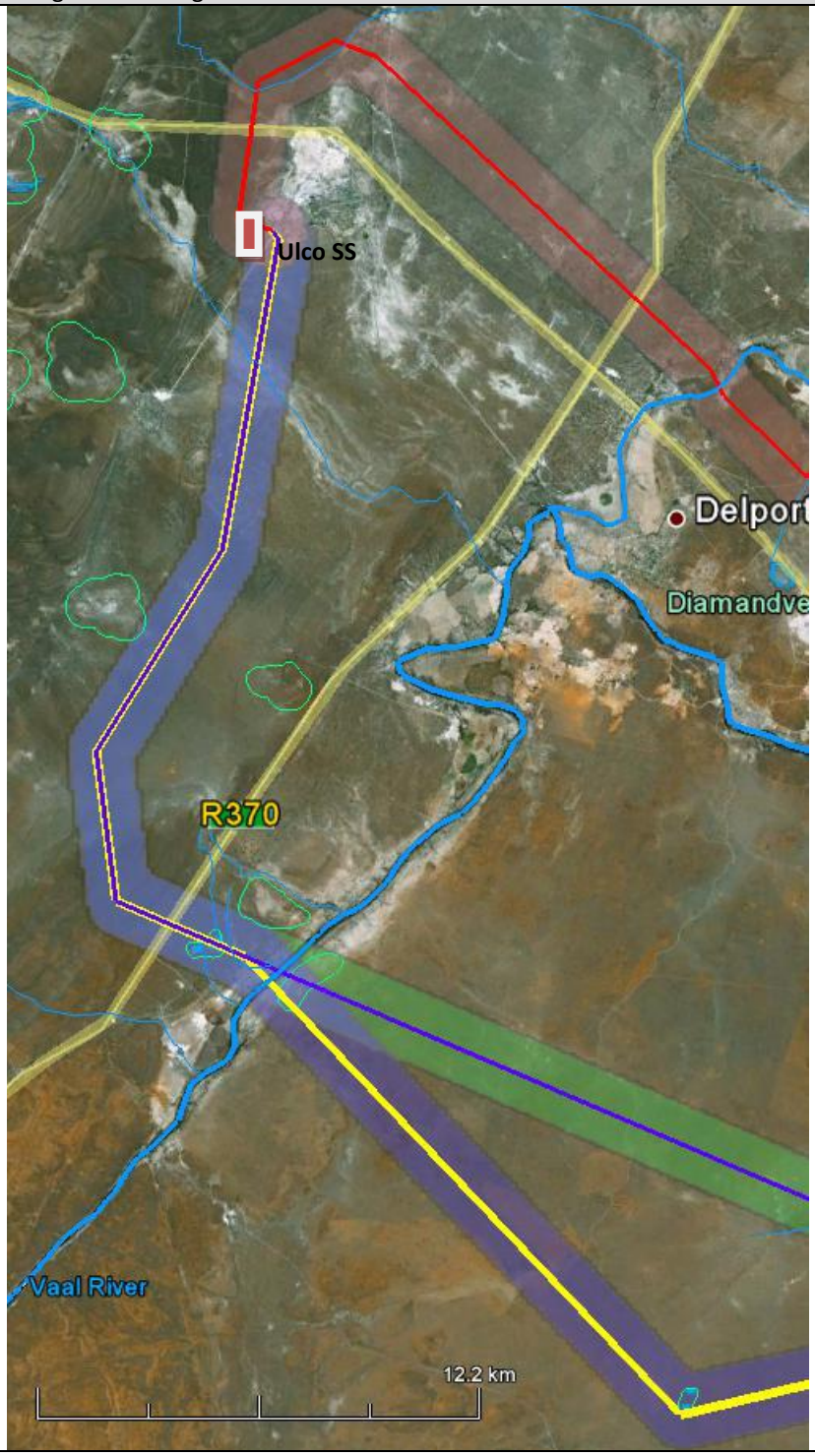
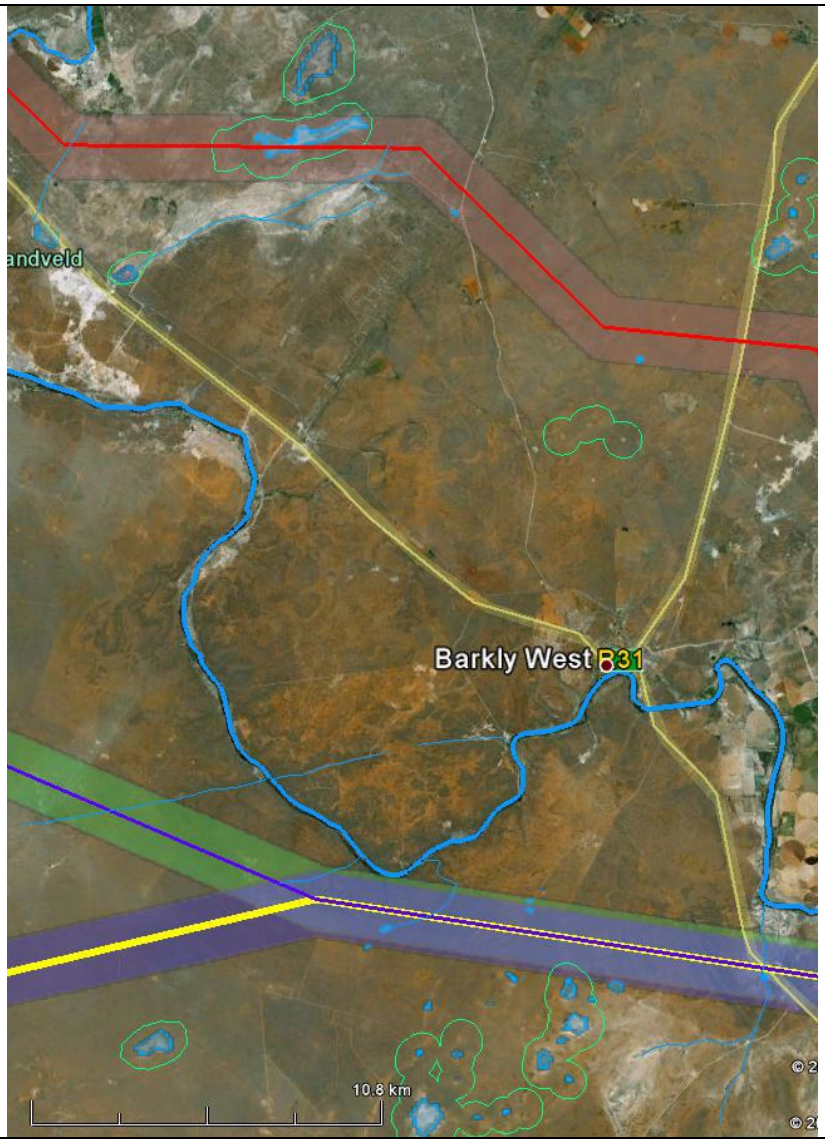


Figure 17: Freshwater constraints map for the alternative routes considered in the Scoping Phase for the proposed new power line, where the red line represents Third Alternative, the purple line is the Second Alternative and the yellow line is the First Alternative

Table 16: Project Constraints related to freshwater features on the alternative power line routes in the Scoping Phase

No.	Google Earth image	Comment
1		**Third Alternative (red line):** The Harts River and a small tributary of the Harts River are crossed by this alternative route for this section. The Harts River is highly modified at the proposed river crossing and is already crossed by an existing line at this point. The small tributary is of a low ecological significance and also relatively impacted by the activities at Ulco. The potential impact of this proposed line for this section would thus be low to very low. **Second Alternative (purple line) and First Alternative (yellow line) :** This alternative route crosses the Lower Vaal Rivera as well as some small of its tributaries, including the Steenbok River. The route also crosses some small pans adjacent to the Vaal River. It is recommended that should this alternative be selected, the structures associated with the power line as well as the access roads would need to be placed outside the proposed buffers for the rivers and pans (green polygons in Google Earth image). **Ulco Substation:** There are no freshwater features in close proximity to the existing substation. The closest freshwater feature is the Steenbok River approximately 2.5km to the south-west of the substation.

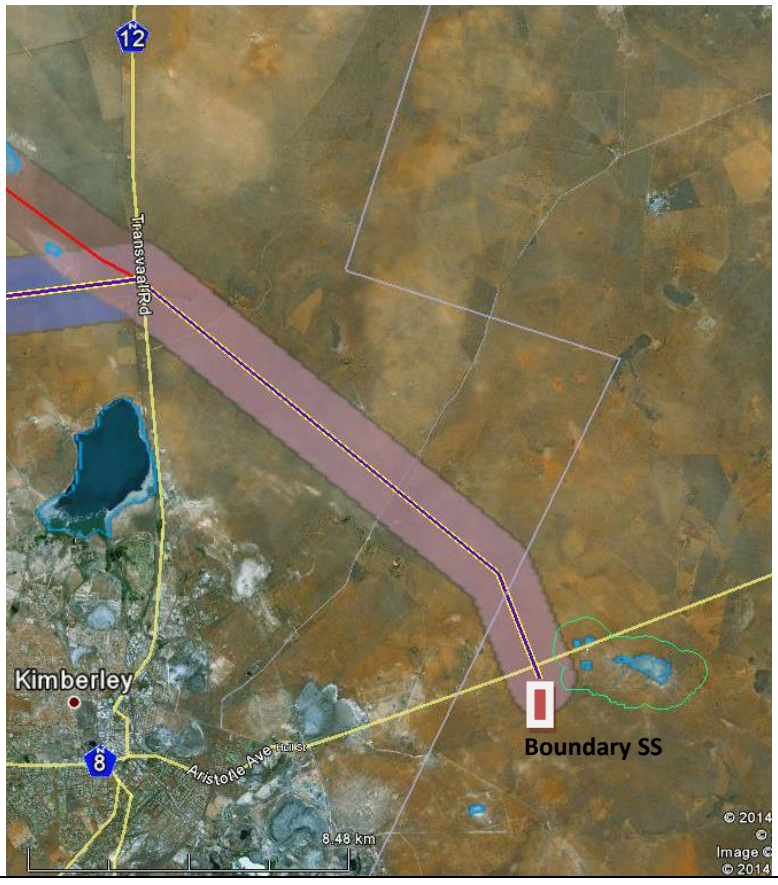
2		**Third Alternative:** Some pans lie within the corridor for this route, with the largest being on Farms 173 and 221 near Longlands. It is advised that this larger pan which is relatively unimpacted be avoided, thus the structures associated with the power line as well as the access roads would need to be placed outside the proposed buffers for the pans (green polygons in Google Earth image). **Second and First Alternative:** These alternative routes cross a number of smaller pans and drainage lines. It is recommended that should one of these alternatives be selected, the structures associated with the power line as well as the access roads would need to be placed outside the proposed buffers for the pans (green polygons in Google Earth image).

3

Third Alternative:
This alternative route would cross the Vaal River upstream of the Harts River confluence. The river here is in a better ecological state and of a high ecological importance and sensitivity. The route will also cross some pans near the N12. The structures associated with the power line as well as the access roads would need to be placed outside the proposed buffers for the pans ((green polygons in Google Earth image).

Second and First Alternative:
These alternative routes would cross some smaller pans, or clusters of pans. It is recommended that should these alternatives be selected, the structures associated with the power line as well as the access roads would need to be placed outside the proposed buffers for the pans ((green polygons in Google Earth image).

4



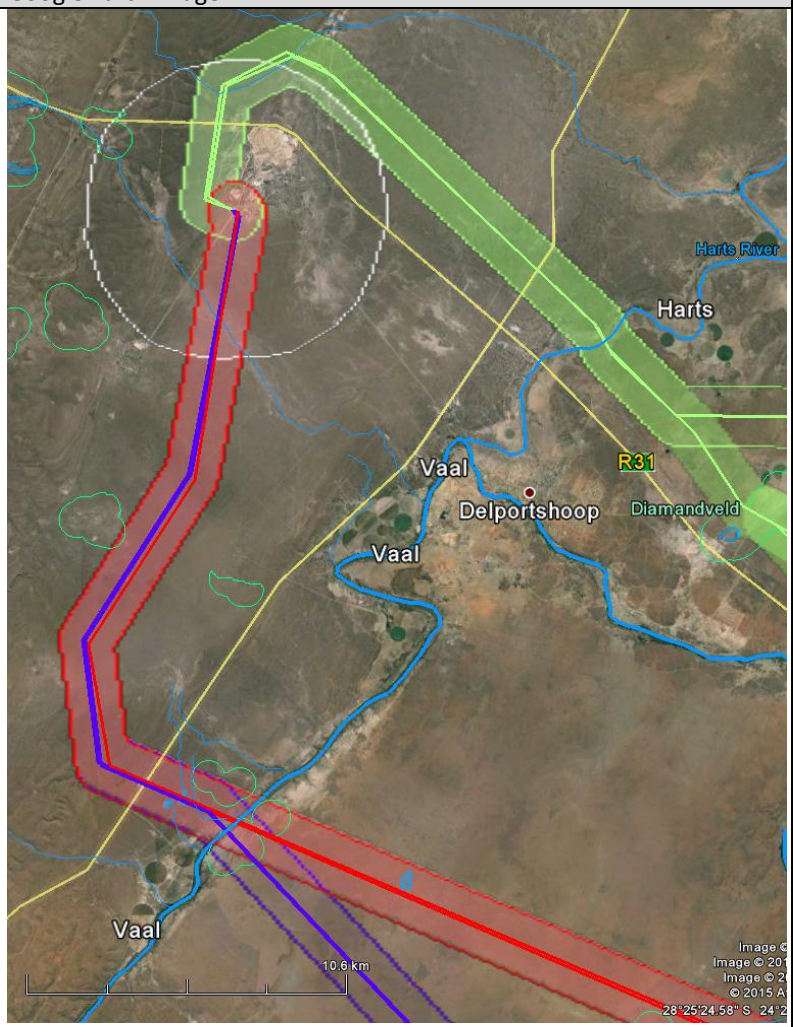
All three alternative Routes:
For this section, all three alternative routes will follow the same path. The alternative routes for the power line will not cross over any significant rivers, pans or drainage lines. The proposed corridor is approximately 2km north of Kamfers Dam as the most significant freshwater feature within this section of the route.

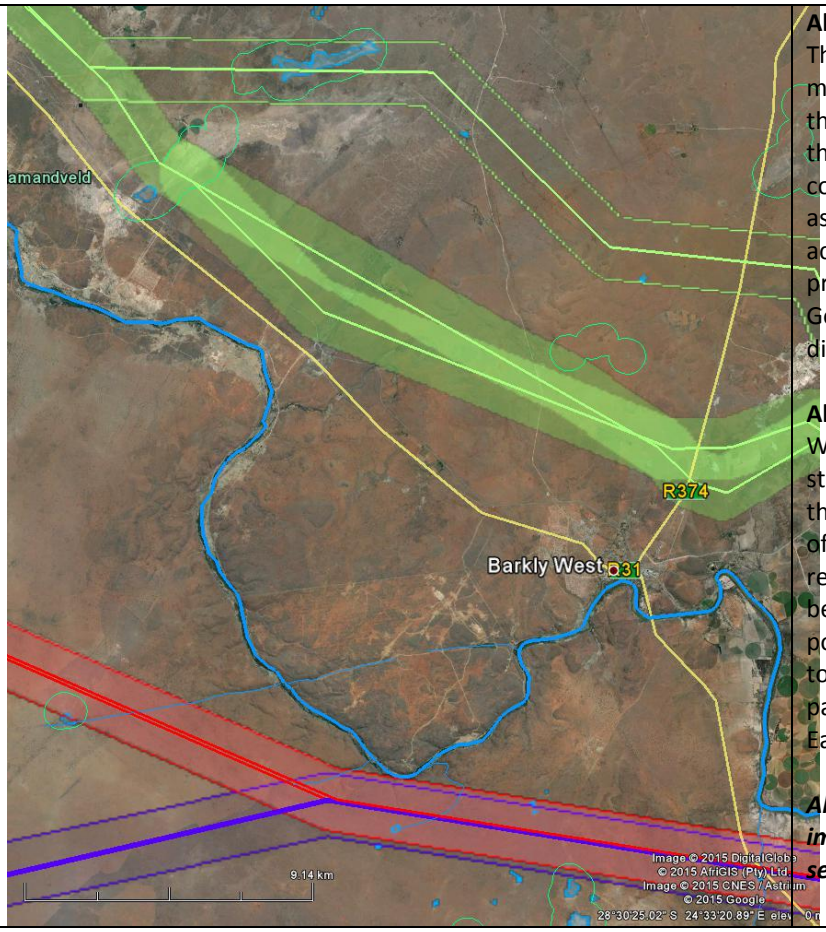
Boundary Substation (addressed in the Beta to Boundary freshwater report):
The proposed expansion of the substation should not take place to the east of the existing substation as some pans are located there.

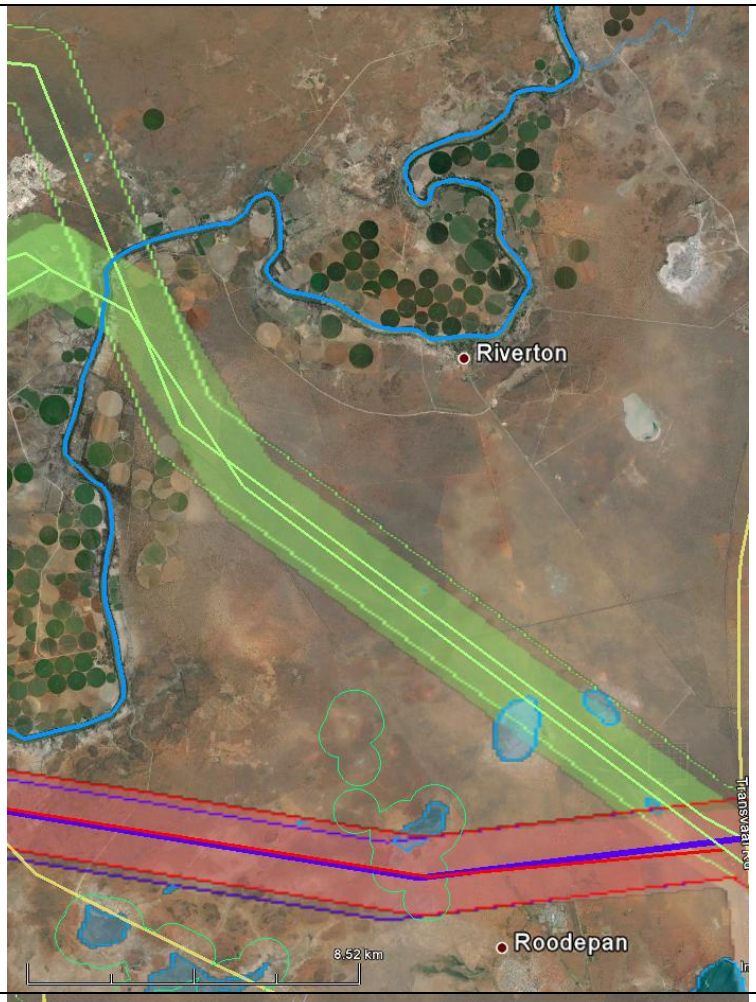
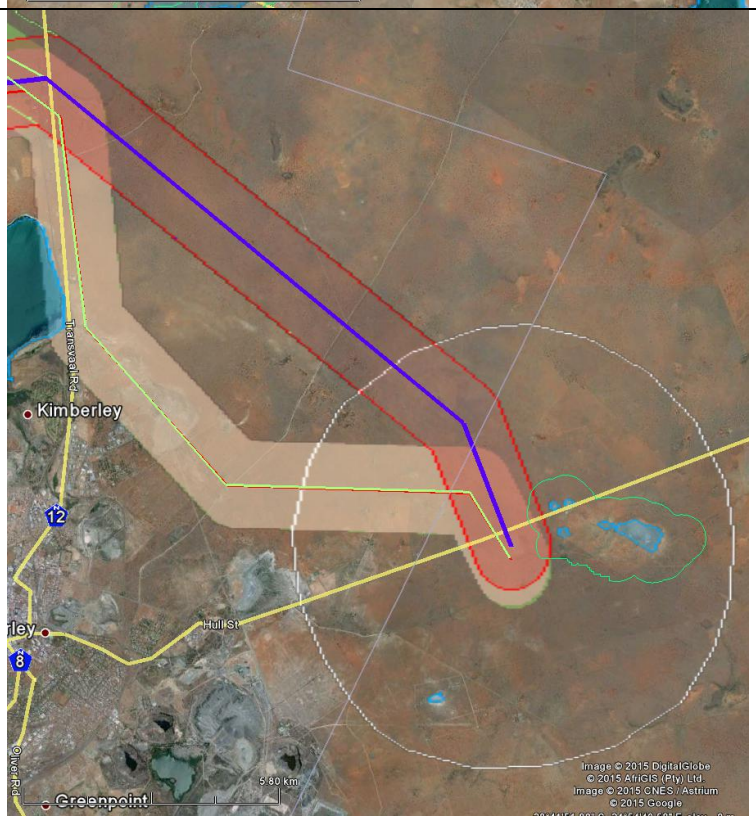
9. CONSIDERATION OF THE ALTERNATIVE ROUTES CONSIDERED AS PART OF THE ENVIRONMENTAL IMPACT PHASE

Two final routes are considered for the Environmental Impact Phase (Figure 18), where a 2km wide corridor is investigated for all the route alternatives. A 5km radius was also considered around the substation sites. These routes have been overlaid in Google Earth on the delineated freshwater features as well as the routes considered in the Scoping Phase for comparison purposes and are discussed in more detail in Table 17 below. The sections discussed in Table 17 relate to the areas indicated in Figure 18.

Table 17: Project Constraints related to freshwater features on the alternative power line routes considered in the Environmental Impact Phase and in comparison to those considered in the Scoping Phase, where the filled green line represents the Alternative One and the filled red line represents Alternative Two considered for the Environmental Impact Phase and their 2km wide corridors; the white circle represents the 5km radius around the substations and the 'unfilled' yellow, purple and red lines represent the First, Second and Third Alternatives considered in the Scoping Phase

No.	Google Earth image	Comment
1		**Alternative One (green line):** Within this section, the route for Alternative One follows the same route as that assessed in the Scoping Phase. The Harts River and a small tributary of the Harts River are crossed by this alternative route for this section. The Harts River is highly modified at the proposed river crossing and is already crossed by an existing line at this point. The small tributary is of a low ecological significance and also relatively impacted by the activities at Ulco. The proposed route should preferably pass south of the tributary rather than needing to cross the watercourse twice. The potential impact of this proposed line for this section would then be low to very low. ***Alternative One is deemed to have the least potential impact on the freshwater features in this section of the route.*** **Alternative Two (red line):** Within this section, the route for Alternative Two follows the same route as that assessed in the Scoping Phase. This alternative route crosses the Lower Vaal River as well as some small of its tributaries, including the Steenbok River. The route also crosses some small pans adjacent to the Vaal River. The structures associated with the power line as well as the access road would need to be placed outside the proposed buffers for the rivers and pans (green polygons). **Ulco Substation:** The Steenbok River and some associated pans are located approximately 2.5km to the west and south-west of the substation. A tributary of the Harts River is located approximately 4km to the north of the substation. The new Ulco Substation should preferably be located to the east of the existing site.

2		**Alternative One:** The revised route for this alternative has been move southwards and largely avoids the pans that were located within the original corridor for this route. There are still some pans within the corridor of the revised route - the structures associated with the power line as well as the access roads should be placed outside the proposed buffers for the pans (green polygons in Google Earth image). There is no significant difference between Alternative One and One (b). **Alternative Two:** Within this section, the route for Alternative Two still follows the same route as that assessed in the Scoping Phase. The route crosses a number of smaller pans and drainage lines. It is recommended that should one of this alternative be selected, the structures associated with the power line as well as the access road would need to be placed outside the proposed buffers for the pans and the rivers (green polygons in Google Earth image). ***Alternative One and Two have similar potential impacts on the freshwater features in this section of the route.***

3		**Alternative One:** This alternative route would cross the Vaal River upstream of the Harts River confluence. The river here is in a better ecological state and of a high ecological importance and sensitivity. The route will also cross some pans near the N12. The structures associated with the power line as well as the access roads would need to be placed outside the proposed buffers for the pans (green polygons in Google Earth image). ***Alternative One is deemed to have the least potential impact on the freshwater features in this section of the route.*** **Alternative Two:** Within this section, the route for Alternative Two still follows the same route as that assessed in the Scoping Phase. The alternative route would cross some smaller pans, or clusters of pans. It is recommended that should these alternatives be selected, the structures associated with the power line as well as the access road would need to be placed outside the proposed buffers for the pans (green polygons in Google Earth image).
4		**Alternative One and Two:** For this section, all the revised alternative routes will follow a path that deviates to the south-west of the routes considered in the Scoping Phase. The new route will follow the N12 towards Kimberley and adjacent to Kamfers Dam as the most significant freshwater feature within this section of the route. Provided that the route lies east of the N12, the impact of the powerline on Kamfers Dam would be insignificant. **Boundary Substation (addressed in the Beta to Boundary freshwater report)**: The proposed expansion of the substation should not take place to the east of the existing substation as some pans are located there. ***Alternative One and Two have similar potential impacts on the freshwater features in this section of the route***

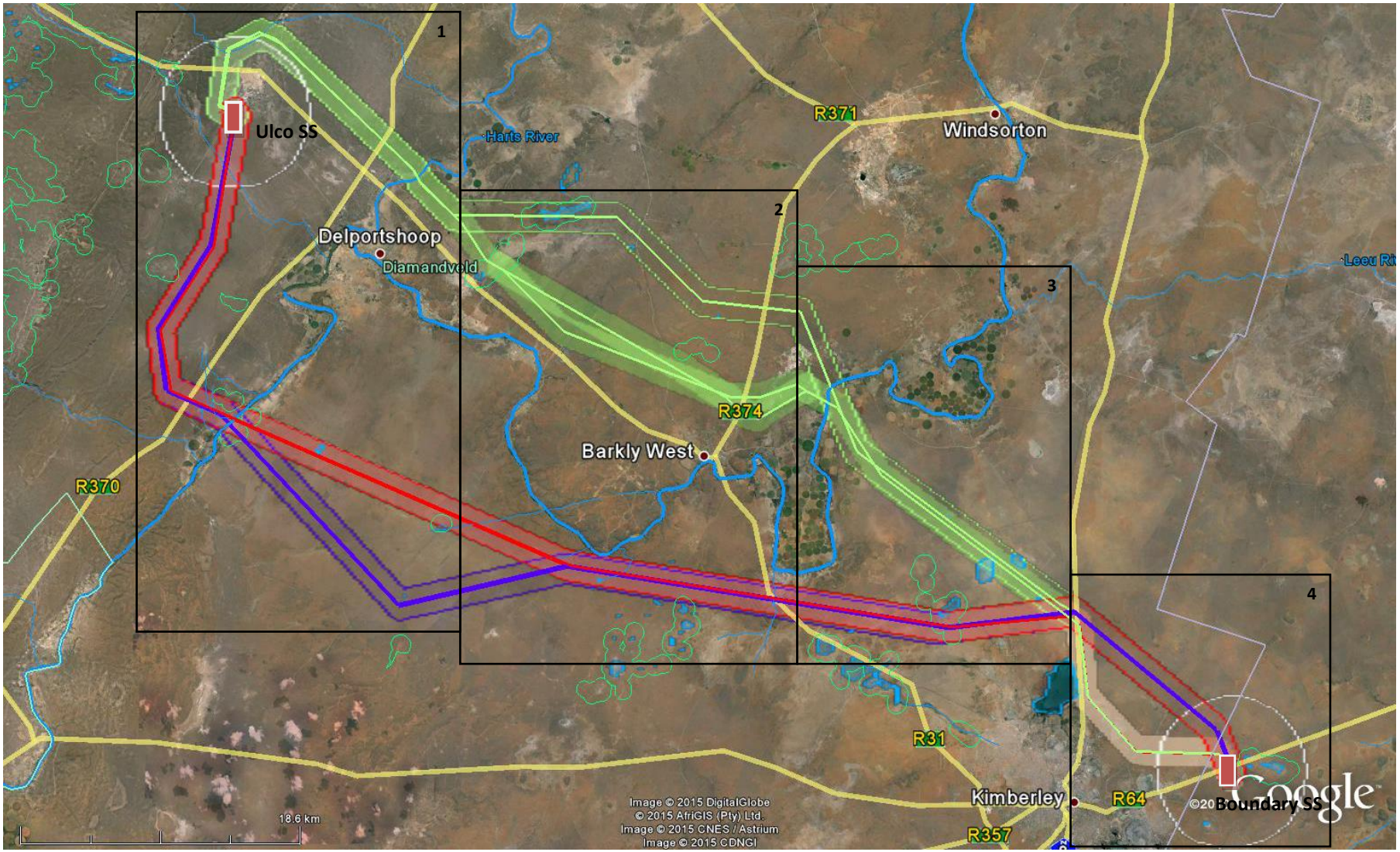


Figure 18: Freshwater constraints map for the alternative routes considered in the Environmental Impact Phase for the proposed new power line, where the filled green line represents Alternative One and the filled red line is the Alternative Two

10. IMPACTS OF PROPOSED OVERHEAD POWER LINE FOR THE ALTERNATIVES

10.1. DESCRIPTION AND ASSESSMENT OF IMPACTS OF PROPOSED ACTIVITIES

This section provides a generic description of the potential impacts to freshwater ecosystems that are likely to be associated with proposed power line development. The potential impacts on the freshwater resources can be divided into impacts associated with the construction of the power lines and those impacts related to the maintenance activities.

IMPACT OF OVERHEAD POWER LINES

Construction Phase Activities

Nature of Impact: Approximately 94km of double circuit 400kV power line is proposed from the Boundary Substation to the Ulco Substation, including a new Ulco TX (Transmission) Substation adjacent to the existing Ulco DX (Distribution) Substation. Activities that would be associated with the construction activities would include the installation of new foundation and poles as well as the establishment of the service road along the line. The impacts will also include the construction of the new substation.

Activities during the construction phase of the project could be expected to result in some disturbance or loss of aquatic habitat for the rivers, drainage lines or pans as well as the associated vegetation cover and where access routes may need to cross freshwater features, where some disturbance to the bed and banks of the drainage features is likely to occur.

Significance of impacts without mitigation: The severity of this impact will depend on the alternative route selected as well as the area in which the substation is to be expanded. Should either Alternative One or the Alternative Two route be selected, then a localized shorter term impact of moderate to low intensity (depending on the distance between the construction activities and the freshwater features) that is expected to have a low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Construction activities should as far as possible be limited to the area outside the proposed buffer zones. In general it can be stated that the mitigation will require a recommended buffer of 50 from the centre of the drainage lines or from the top of bank of the Vaal, Steenbok and Harts rivers and approximately 500m (varies depending on wetland cluster) from the edge of the pans.

The significance of the potential freshwater impact relating to both proposed routes, is very similar. Alternative One will need to cross over the Vaal River upstream of the Harts River confluence. The river here is in a better ecological state and of a high ecological importance and sensitivity. However, Alternative Two for much of its route crosses an area that is much less developed and thus the terrestrial and freshwater features within this area are in a better condition.

Neither the monopoles nor the anchors should be constructed within the proposed buffer zones. If the proposed routes for the power lines are to be changed due to recommendations from the EIA process the generic recommendations in terms of the buffer zones must be applied. The power lines may cross over the buffer zones for the pans and drainage lines as the limitations are not applicable to overhead infrastructure.

It is important that any of the cleared areas that are not hardened surfaces are rehabilitated after construction is completed by re-vegetating the areas disturbed by the construction activities with suitable indigenous plants. Any invasive alien plants that currently exist within the immediate area of the construction activities should also be removed and any regrowth prevented and managed.

Where possible, existing service roads should be used to maintain the power lines rather than creating new ones. To reduce the risk of erosion, run-off over the exposed areas should be mitigated to reduce the rate and volume of run-off and prevent erosion occurring within the freshwater features and drainage lines.

Contaminated runoff from the construction sites should be prevented from entering the rivers/streams. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 50m away from the river/stream systems and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase.

Significance of impacts after mitigation: A localized, short-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be very low.

Operation Phase Activities

- Nature of Impact: Some disturbance of the freshwater features in the area of the constructed power line could be expected that would be associated with the maintenance activities for the project.

  Significance of impacts without mitigation: The severity of this impact will depend on the alternative route selected as well as the area in which the substations are to be expanded. A localized longer term impact of low intensity that is expected to have a very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

  Proposed mitigation: All crossings over the rivers, drainage channels or within the pans and their buffer zones after the construction phase should be rehabilitated. Maintenance of the power lines should only take place via the designated access routes. The establishment of alien vegetation in the riparian zones should specifically be prevented, and controlled if it does occur.

Significance of impacts after mitigation: A localized, long-term impact of a very low overall significance could be expected to occur.

IMPACT OF THE ACCESS ROUTES:

Construction Phase Activities

- Nature of Impact: The major impacts associated with the access roads relate to the potential loss of habitat within pans, rivers and the drainage channels, invasive alien plant growth, flow and water quality impacts and erosion of drainage channels or river banks.

  Significance of impacts without mitigation: The severity of this impact will depend on the alternative route selected as well as the area in which the substation is to be expanded. A localized shorter term impact of moderate to low intensity that is expected to have a low to very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

  Proposed mitigation: The existing road infrastructure should be utilized as far as possible to minimize the overall disturbance created by the proposed project. Where access routes need to be constructed through drainage channels, disturbance of the channel should be limited and multiple crossings should not be created. Any new roads should remain outside of the buffer of 50 from the centre of the drainage lines or from the top of bank of the Vaal, Steenbok and Harts rivers and approximately 500m (varies depending on wetland cluster) from the edge of the pans.

  All crossings through drainage channels or minor stream beds should be such that the flow within the drainage/stream channel is not impeded. Road infrastructure and cable alignments should coincide as much as possible to minimize the impact. Any disturbed areas should be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.

  Significance of impacts after mitigation: A localized, short-term impact will occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

Operation Phase Activities

- Nature of Impact: The major impacts associated with the access roads during the operation phase relate to disturbance to the instream and riparian habitat of the freshwater ecosystems along the designated routes.

  Significance of impacts without mitigation: The severity of this impact will depend on the alternative route selected as well as the area in which the substations are to be expanded. A localized longer term impact of moderate to low intensity that is expected to have a low to

very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Maintenance of infrastructure related to the project should only take place via the designated access routes. Disturbed areas along the access routes should be monitored to ensure that these areas do not become subject to erosion or invasive alien plant growth.

Significance of impacts after mitigation: A localized, longer-term impact will occur during the operation phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

10.2. CUMULATIVE IMPACT OF THE ACTIVITIES ON FRESHWATER ECOSYSTEMS

Erosion and sedimentation from the project activities, together with invasive alien plant growth and the possible modification of surface water runoff and water quality may lead to additional impacts on the freshwater habitats within the study area. These impacts are likely to be of a low significance and can be monitored and easily mitigated. As far as possible the proposed lines should share access routes with existing lines or along existing roads to minimise the increase in the disturbance of the area and its freshwater features.

10.3. SUMMARY IMPACT TABLE

Table 18 provides a summary of the potential impacts of the proposed activities on the freshwater features in the study area. A comparison of the two final alternative routes considered in the Environmental Impact Phase of the project is also provided in the table.

All of the proposed activities for the alternatives will have a low to no significance impact with mitigation (including final route selection), both within the construction and operation phases of the project. Both Alternative One and Two will have impacts of a very similar, low significance on the freshwater features in the study area.

Table 18 Summary Impact Table for the proposed activities as well as the alternative routes

Activity / Alternative Route	Impact Description	Severity of Impact without Mitigation	Extent	Duration	Probability	Magnitude / Intensity	Severity of Impact After Mitigation
Construction Phase							
Overhead power lines – Alternative One	Disturbance / loss of aquatic habitat	Moderate to Low	Site/Local	Short	Probable	Low	Low
Overhead power lines – Alternative Two	Disturbance / loss of aquatic habitat	Moderate to Low	Site/Local	Short	Probable	Low	Low
Access roads – Alternative One	Disturbance / loss of aquatic habitat; flow and water quality modification	Moderate to Low	Site/Local	Short	Probable	Moderate to Low	Low
Access roads – Alternative Two	Disturbance / loss of aquatic habitat, flow and water quality modification	Moderate to Low	Site/Local	Short	Probable	Moderate to Low	Low
Construction of New Ulco Substation	Disturbance / loss of aquatic habitat, flow and water quality modification	Moderate to Low	Local	Short	Possible	Moderate	Low
Operation Phase							
Infrastructure maintenance – Alternative One	Disturbance / loss of aquatic habitat	Moderate to Low	Site	Long	Possible	Low	Low to None
Infrastructure maintenance – Alternative One	Disturbance / loss of aquatic habitat	Moderate to Low	Site	Long	Possible	Low	Low to None

11. CONCLUSIONS AND RECOMMENDATIONS

The aquatic features occurring within the study area consist of the lower Vaal and Harts rivers and some endorheic pans and streams or drainage lines. The habitat integrity of the Lower Vaal and Lower Harts rivers within the study area is deemed to be in a largely to severely modified state while all of the other tributaries in the area are in a largely natural to moderately modified state. The riparian habitat tends to be more impacted by the surrounding farming activities. The pans in the study area are subjected to physical habitat modification with some flow and water quality modification largely as a result of the surrounding farming and peri-urban activities. In terms of the current ecological state of the wetland areas, they are as a whole considered to be in a moderately modified state.

The ecological importance and sensitivity of the rivers within the study area is deemed to be high or moderate, with the Lower Vaal River upstream of the Harts River confluence having the highest ecological importance. The smaller drainage lines have a low ecological significance. The pans within the study area are in general small and of limited ecological importance.

Where the proposed power lines are located close to freshwater features it is proposed that a buffer of 50 from the centre of the drainage lines or from the top of bank of the Vaal, Steenbok and Harts rivers and approximately 500m (varies depending on wetland cluster) from the edge of the pans be implemented. Tributaries of the Vaal and Harts River occur more than 3km to the north and south-west of the existing substation. The new Ulco Substation should therefore preferably be located to the east of the existing substation.

Providing that the recommended mitigation measures are implemented (adherence to the proposed buffers adjacent to freshwater features, minimisation of impacts and rehabilitation of disturbed areas and the utilisation of the existing access roads where possible) the significance of the impact for all of the proposed activities of the alternatives of final route selection is expected very low, both within the construction and operation phases of the project. Thus Alternative One and Two would both have impacts of a low significance on the freshwater features in the area.

A water use authorization may need to be obtained from the Department of Water Affairs Northern Cape Regional Office for approval of the water use aspects of the proposed activities.

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